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# Compressed Air Magazine

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## JULY, 1922

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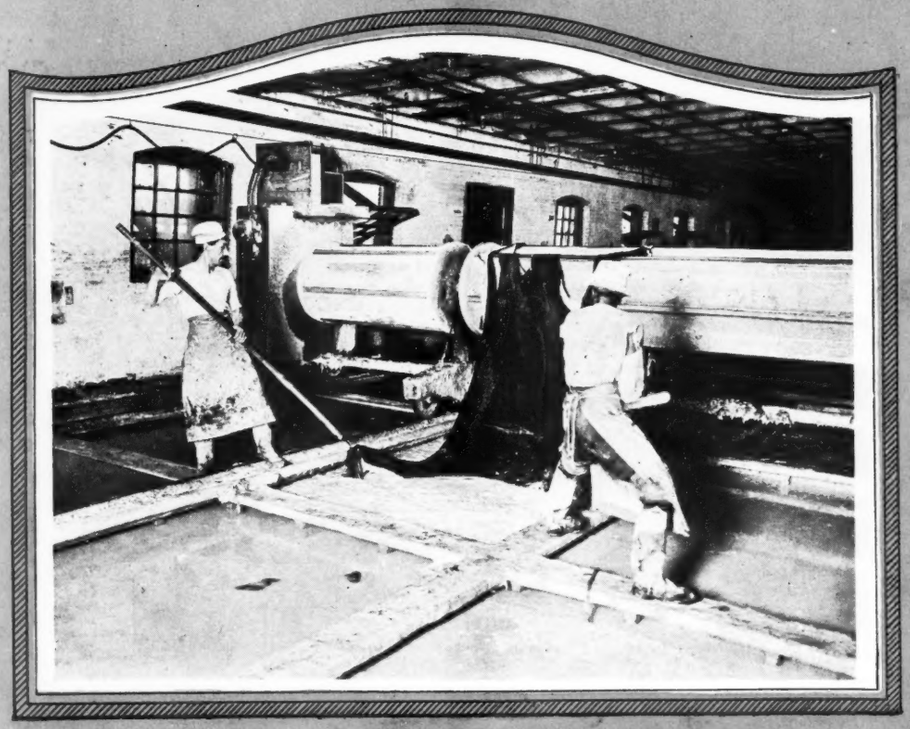

*REELING HIDES INTO LIME LIQUOR AFTER THE LATTER HAS BEEN THOROUGHLY AGITATED BY COMPRESSED AIR*

**The Modern Method of Tanning Sole Leather**
Robert G. Skerrett

**Compressed Air in the Foundry**
L. W. Schnitzer

**Compressed Air for Cleaning Gas Piping**
J. T. Griffin

**The Manufacture of Naval Stores**
N. S. Greensfelder

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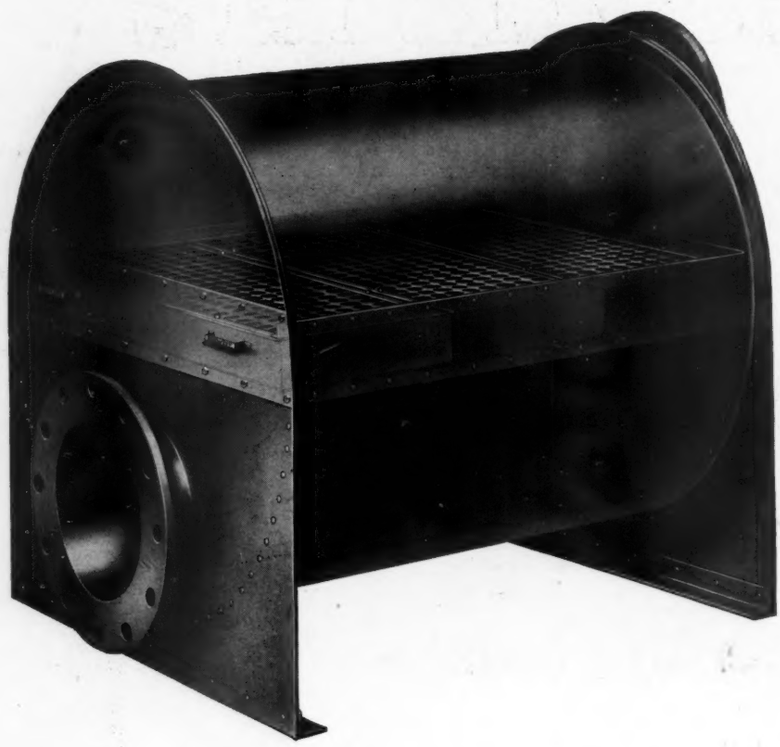
IF dirt and dust cause shut-downs—loss of time—and expense in operating your air compressors, you will find complete relief by installing the MIDWEST UNIT AIR FILTER (COMPRESSOR TYPE)



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# Compressed Air Magazine

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JULY, 1922

# The Modern Method of Tanning Sole Leather

## Compressed Air as an Agitating Medium for Various Liquors Employed in the Tanning Process and For Other General Purposes is Essential For Economical Plant Operation

By ROBERT G. SKERRETT

HOW MANY of us realize what leather represents as an evidence of industry? And how many of us are aware of the allied activities which are dependent upon leather as a basic raw material in the fabrication of their diversified products? Leather, in short, is intimately identified with some of the dominating departments of our economic life. To be specific, according to the value of the goods turned out by the 350 and more classified industries in the United States, the boot and shoe industry ranks fourteenth, while that of leather, tanned and curried, is rated twenty-first.

What is commonly understood by the term leather industry embraces not only the production of leather, as such, but likewise the manufacture of boots and shoes; cut stock; findings; belting; gloves and mittens; saddlery and harness; trunks and valises; pocketbooks; etc, etc. The capital invested in these several enterprises amounts to quite $1,553,837,000. Imposing as this showing is, perhaps a more detailed presentation of the facts concerning two branches of the leather industry will prove illuminating, and the following data are drawn from the Census of Manufactures for 1919—the latest authentic information available.

LEATHER INDUSTRY IN THE UNITED STATES

| | Leather | Boots and Shoes |
|---|---|---|
| Number of establishments | 680 | 1,449 |
| Capital | $671,341,553 | $612,625,075 |
| Average number of wage earners | 72,476 | 211,049 |
| Wages | $88,205,473 | $210,734,610 |
| Cost of materials | $646,521,527 | $715,269,315 |
| Value of products | $928,591,701 | $1,155,041,436 |
| Value added by manufacture | $282,070,174 | $439,772,121 |
| Primary horse power | 218,238 | 120,632 |

**THE LEATHER industry ranks among the foremost in the United States and embraces not alone the production of leather but the manufacture of many different products such as boots and shoes, belting, saddlery and harness, trunks and valises, and numerous other articles in common use.**

**Compressed air is used for agitating the liquors in the main mixing tanks and other vats employed in the process of tanning leather and has proved superior to the hand or power driven paddle, not alone because of the increased production obtained, but in improving the action of the liquors to a marked degree.**

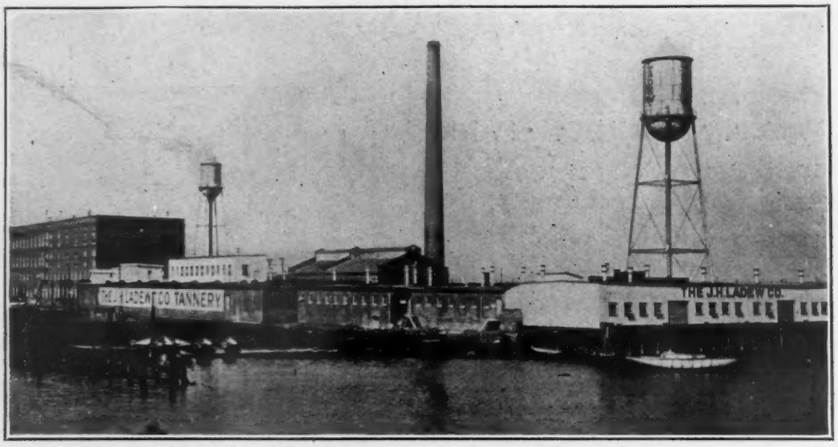
**Agitation by air insures a thorough mixing of the liquors in the vats and is more reliable and less troublesome in its operation than other forms of mechanical agitation.**

Judged by the value of products, the foregoing departments of the combined leather group represent 79.8 per cent. of the business, with leather equalling 35.6 per cent. and boots and shoes totalling 44.2 per cent. In the course of a year our factories turn out normally about 300,000,000 pairs of boots and shoes; but we are not the only beneficiaries of this tremendous activity. For example, during 1921 we shipped abroad 9,000,000 pairs of boots and shoes for men, women and children.

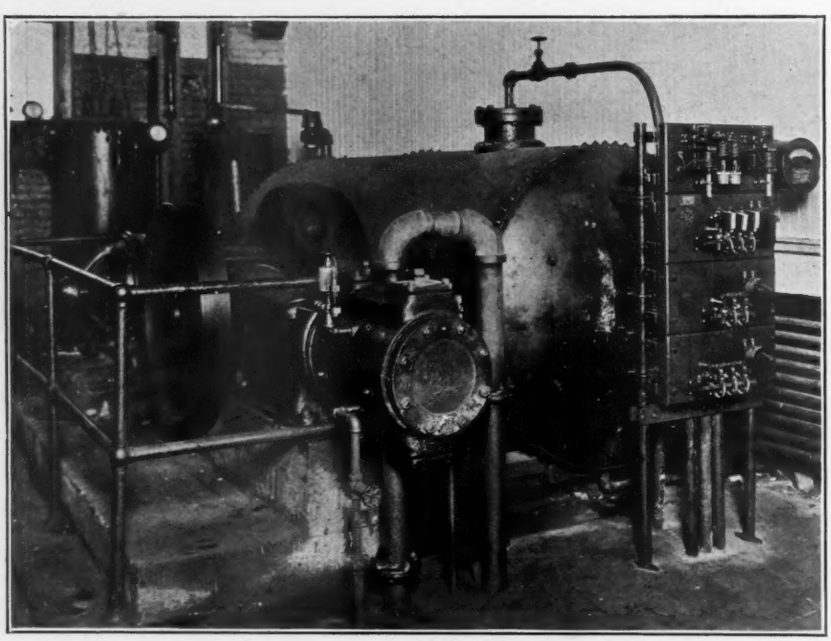
While our domestic herds and flocks can supply us with but 60 per cent. of the hides and skins needed by our tanners, and we must, therefore, go abroad for the rest of our raw material, still we enjoy a far better position in the matter of finished products. Prior to the war we controlled something like 25 per cent. of the world's leather trade, and at the present time we contribute about one-third to the world's total commerce in leather. The American tanner has long been at the forefront of his art, and the excellence of his commodities is the result of a combination of technical skill and the employment of up-to-date mechanical facilities.

The durability of boots and shoes, in the main, is dependent upon the character of the leather worked into the soles either by the manufacturer or the cobbler. In other words, sole leather constitutes the very foundation of satisfactory footwear. According to the census of 1919, we then produced 591,474,000 pounds of sole leather, valued at $218,830,000. Sole leather has always been conspicuous among our exports of finished leather; and last year we sent out of the country a total of 14,412,000 pounds of this stuff. And now we come to the purpose of this article—a description of a thoroughly up-to-date plant engaged in the tanning of sole leather of the highest quality. But first let us consider leather as a physical entity—the outcome of the special treatment of "green" hides or skins.

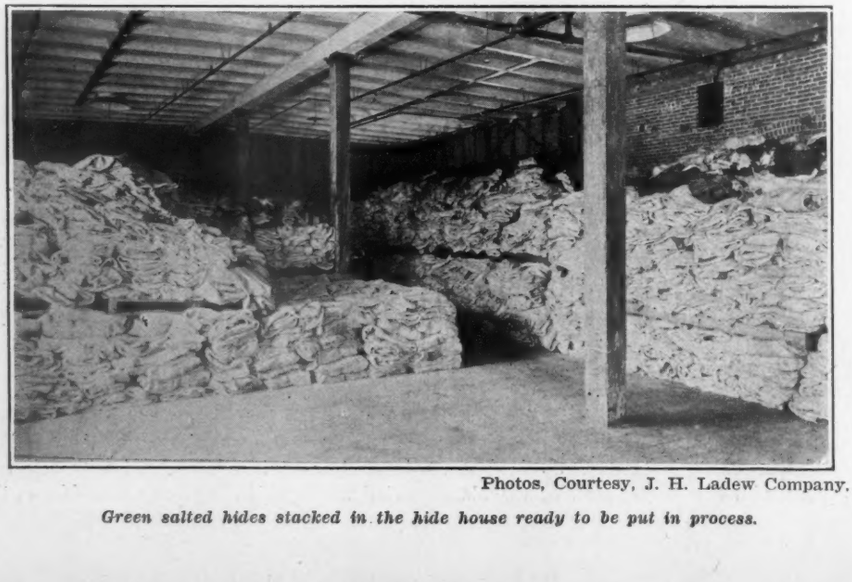
Just why leather is leather nobody knows; but the chemist and the tanner are alive to the fact that tannin in some way works a transformation in the raw material, preserves the skin or hide from putrefaction, and incidentally insures other desirable properties. Moreover, the scientific world has not yet chemically identified tannin, although the man of the laboratory will give us a list of the substances from which it can be obtained; and the presence of tannin can always be detected and its strength approximated by the reactions induced when it is associated with salt and gelatin. These details give us some idea of the




*The up-to-date plant of the J. H. Ladew Company.*



*Electrically-driven compressor which automatically maintains a supply of compressed air at 75 pounds pressure in the adjoining receiver. The compressed air plant at the J. H. Ladew Company's tannery.*



Photos, Courtesy, J. H. Ladew Company.

*Green salted hides stacked in the hide house ready to be put in process.*

empirical character of the tanning industry and, in part, explain how the whole art is built upon practices evolved through centuries—practices which the tanner hesitates to change because he is still largely ignorant of what is actually taking place in some of his vats.

The skins of all vertebrate creatures are composed of four layers or membranes. The outer one is the epidermis, which carries the hair; the second one contains the nerves, the smaller blood vessels, etc.; the third, or middle portion, is the dermis or true skin which is made up of fibers intimately interwoven in every direction; and the fourth, or innermost layer, is the fat-bearing tissue directly overlying the flesh. The fibrous true skin is the substance which forms the basis for leather.

At the J. H. Ladew Company's tannery in Newark, New Jersey, sole leather is made from what are known to the trade as "Frigorificos," hides from Argentina. The manner of cleaning these cattle hides after they are flayed from the animals, and before they are salted to preserve them for export, makes them especially desirable as a raw product, and there is less waste material when they are processed at the tannery. Besides, because of their better condition, less time is required to prepare them for tanning.

The first step in manipulating the "green," salted hide is to place it in a wheel or large revolving cylinder, commonly called a drum, where the mechanical action serves not only to soften the hide but to knead out of it dirt, blood, and salt. Next, the hide is soaked in soft water for 24 hours. Some 60 of these hides are toggled or fastened together in a string so that they can be successively reeled into lime liquors of varying strength contained in a series of wood or cement-lined pits. To the bath of slackened lime is usually added a percentage of sulphide of sodium, and the joint effect of the lime and the sodium is to loosen the hair, so that it can be readily removed by scraping, and also to produce a degree of plumpness. In this "plumped" condition the hides are especially receptive to the action of the tanning fluid. It takes about three minutes to reel 60 hides from one vat into another; and the liming process extends over an interval of from six to seven days. Liming is accomplished more rapidly during the summer season, for when the hides are warm the hair will come off easier.

Liming is a very important stage preliminary to the actual tanning; and to insure the uniform and thorough action of the lime liquor it is necessary to stir the mixture in each vat at frequent intervals. Similarly, it is equally essential that the lime liquor be well agitated in the main mixing tank from which the initial supply is fed to the vats. Owing to the low solubility of lime and the tendency of the alkali to precipitate, mechanical stirring is not entirely satisfactory. Therefore, at the plant in question, the contents of the main mixing tank is agitated both by a subaqueous discharge of compressed air and a power-driven paddle while the liquors in the several vats are stirred up by compressed air alone. The lime bath in every vat is thus "plunged" before reeling into it a string of hides; and this

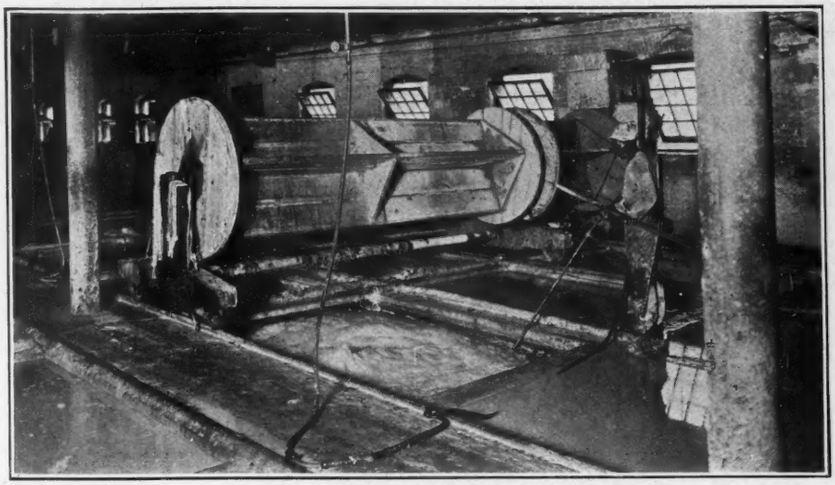
plunging is continued long enough to produce a thick, creamy froth on top of the mixture.

Prior to the adoption of compressed-air plunging, the work was done with paddles by hand, but the substitution of air plunging has speeded up operations and has also improved the action of the liquors to a marked degree. The subaqueous discharge of compressed air goes on all the while, even when there are no hides in a vat, but the volume of air employed then is not so great as that used during the plunging of the mixture just prior to reeling in hides. Fully 400 hides are handled daily—each hide weighs on an average of 60 pounds, and this means the shifting and manipulating of substantially 24 tons of material.

When the hides are removed from the last and strongest of the lime liquors, they are passed to the unhairing machines. These apparatus consist principally of a pair of parallel metal rollers whose surfaces carry opposing series of dull spiral ridges. These scrape off the hair without cutting the hide and, at the same time, slightly stretch the hide while it is traveling between them. In older tanneries, the hides are still placed upon "beams"—slightly crowned, slanting boards—where the hair is scraped off manually. In the up-to-date establishment beams are used only to get rid of any flesh clinging to the edges of the hide, inasmuch as the hide is fleshed on a fleshing machine immediately after being mechanically unhaired. By this procedure, any surplus flesh left on the hide by the packers is taken off and the hide is thus thoroughly cleaned on the flesh side. It may be interesting to note here that "fleshings" are sold for glue stock, and that the cattle hair is utilized in making mats and some grades of cloth, while much of the hair is in demand among plasterers.

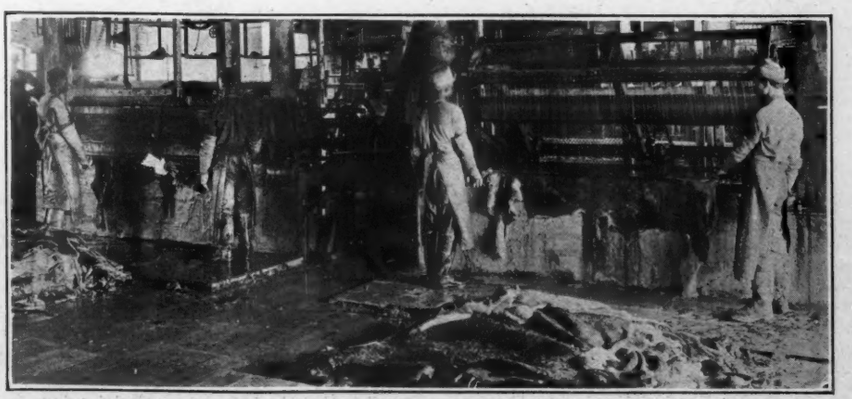
Before the unhaired hides enter the tanning vats, located in the Rocker Yard, they must be delimed for a period of from eighteen to 24 hours, and to facilitate this process, the hides are put in large revolving wheels or drums charged continually with fresh water. These drums are in the Beam House where generous quantities of water must be available at all times which is obtained from a bored well 400 feet deep. The water is raised 350 feet by an air lift, and this apparatus furnishes 25,000 gallons daily. Air for the operation of the lift is drawn from a receiver which is kept automatically charged at a pressure of 75 pounds by a single compressor, driven by a 25-horsepower electric motor. Air is also tapped from this same reservoir for the several other services to which this medium is put, and is employed without any reduction in pressure.

With the deliming completed the hides are now ready for tanning, and are taken into the Rocker Yard. This department of the plant contains a series of vats or pits filled with tanning liquors, and these mixtures become stronger as the process progresses. This gradual enriching of the liquors induces complete penetration of the tannin: an initially strong mixture would tan the outer surfaces of the hide too rapidly and arrest the thorough permeation of the preserving extract. Im-

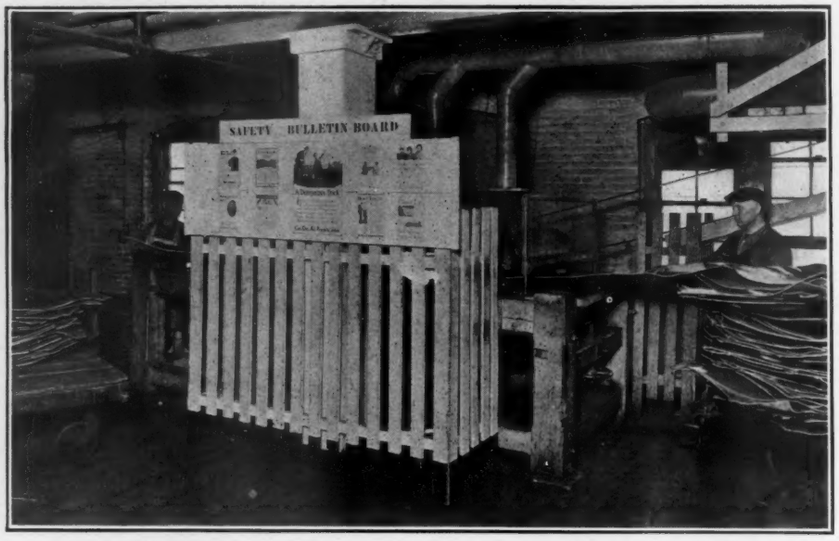


*"Plunging" or stirring up a lime bath preliminary to reeling in a "string" of hides.*

*One view of the beam house, with a lot of washed hides ready to be placed in the lime liquors in the near-by tanks.*



*Unhairing machines which treat the hides after they are removed from the lime liquors.*



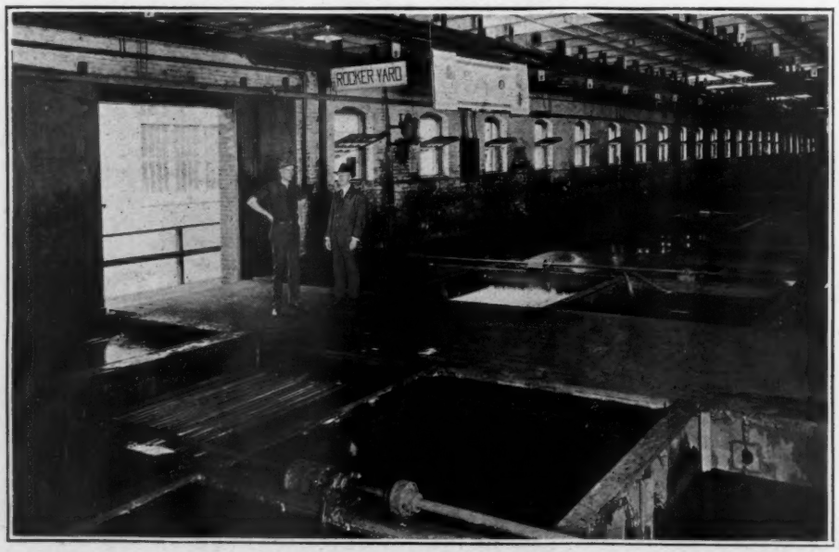

*A brushing machine. This brushes the leather and makes it ready for shipment.*

perfectly tanned leather is apt to decay quickly, and its appearance and texture make it unacceptable to the trade. It should therefore be evident that the nice control of the condition of the tanning fluids in the different vats is of prime importance.

At the Ladew tannery, the tanning liquors are first prepared and held ready for distribution in storage tanks of 25,000 gallons capacity. In the bottoms of these tanks are installed air lines which are connected with the compressed air system. Agitation by air insures a thorough mixing of the contents before these new liquors are fed to the tanning vats in which the liquors have become more or less spent through use. By recourse to jets of compressed air not only is complete mixing assured but reliance upon troublesome and expensive mechanical aids, in the shape of power-driven paddles, etc., is obviated.

The Rocker Yard is so termed because of the equipment employed to give the hides a slight and continuous up-and-down movement while hung upon frames suspended in the tanning vats. Each hide is secured to a bar carried by the frame; and a frame will thus accommodate a lot of 32 hides. The rocking action is effected by an electrically-driven line shaft upon which are mounted a series of eccentrics. The latter, through interposed eccentric rods, rock other line shafting run across the tops of the tanning vats. Let us follow the treatment of a single lot of hides during their manipulation in the Rocker Yard.

Pendant from a frame, the hides are submerged and rocked for from ten to fifteen days, and every 24 hours the liquor is "pressed" or strengthened by the admission of liquor of greater specific gravity. The tanks are intercommunicating through passages at the top of the separating walls; and thus the greater specific gravity of the liquor in one vat tends to force or press all of it into a neighboring vat holding a slightly weaker solution. No hides are moved once they are placed in the rocker vats until they are taken to the layaway vats, because the pressing process changes the liquor and obviates moving the hides.




*The Rocker Yard of the Ladew Tannery. Here it is that the hides are soaked for days in pits filled with tanning liquors.*

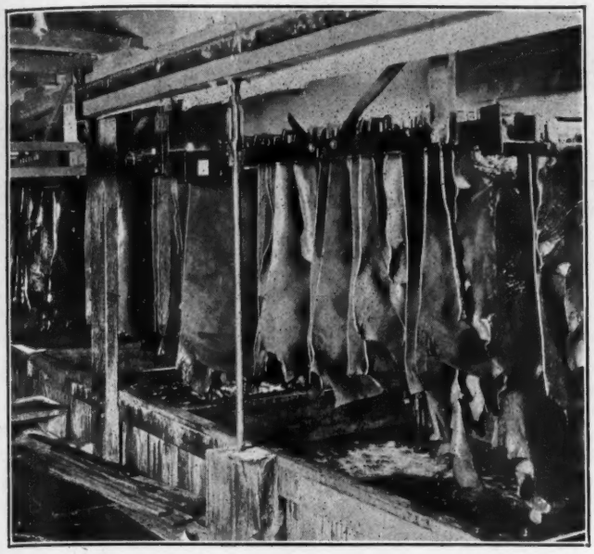
Labor saving is the object of this modern practice. The shifting of the hides daily, from vat to vat, in the old days was not only tedious but it consumed a good deal of time. From the rocker the hides are transferred to a layaway vat, where they remain for ten or twenty days with a little ground bark thrown in between them to keep them separate so as to enable the new and rich liquor to reach and to penetrate every part of the hides.

Next, the hides are pulled out of this vat and put on the floor of the Layaway Yard, and fresh and stronger liquor is placed in the vat after which the hides are put back in the vat for another ten or twenty days. This procedure may be repeated three or five times, depending upon conditions, i. e., the character of the hides and the quality of sole leather desired. With this stage of the tanning done the work of the Layaway Yard is finished by trimming off the bellies of the hides, which are used for inner soles, counters, and heels, and by splitting the large remaining portion of the hide down the center, making two "backs."

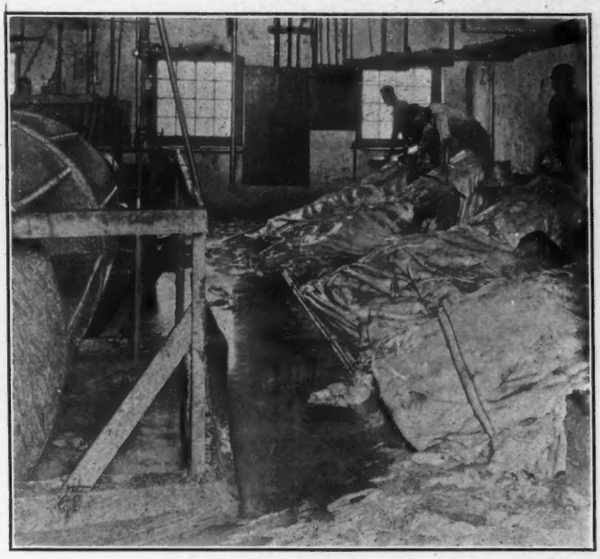
From the Layaway Yard the hides, which are now leather, are placed in revolving drums charged with extract, and here they receive the final touch of the tanning process. The net effect of the several steps that have gone before is, first, to separate the hide fibers which are closely intermingled and cemented together in a dry hide and, then, to impregnate the hide substance with a material which will hold the fibrils apart, pack the interstices so as to make the leather water-proof and to render it non-putrescible. In the Ladew plant these ends are realized by means of vegetable tannin.

After leaving the drums, just referred to, the hides are laid away in tempering vats for four days, and at the conclusion of that interval they are ready to be bleached. The term bleaching is something of a misnomer, for the object of the treatment is really not to bleach but to impart to the surface or "grain" of the leather a uniform color by eliminating spots due to oxidation or to an uneven distribution of the deposited tannin. The bleaching must be done with much care lest the effects of the tanning be neutralized and the leather injured. Once more, compressed air is utilized to assist in obtaining the desired results.

The bleaching vats are five in number, and the liquids in them are held at a temperature of from 120 to 130 degrees Fahrenheit. The first one is filled with water; in the second the liquor is alkaline and serves to bring free tannin to the surface; the third bath is an acid one, and this clears away the surface tannin; while the fourth bath, of a weakened acid nature, finishes the removal of the objectionable tannin. The bleaching operation is ended by dousing the leather in cold, running water in the fifth vat. During the several stages of bleaching, the leather is soaked in each vat for five minutes. At the conclusion of every five minute interval, a bell rings to notify the operatives that it is time to shift the leather from one tank to another, and, automatically, air is blown into the vats—the plunging going on for two minutes. This plunging and the addition of a suitable amount of fresh chem-

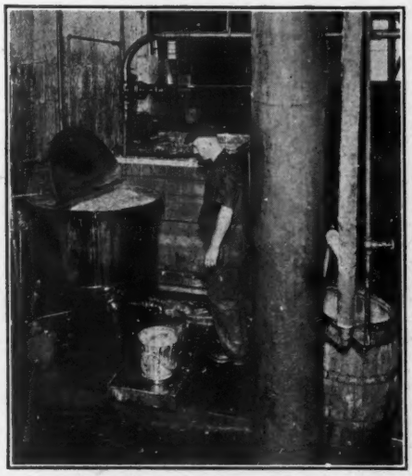


*Bleaching vats, where free or surface tan is removed from the hides. In sole leather the uniformity of color is an important matter.*

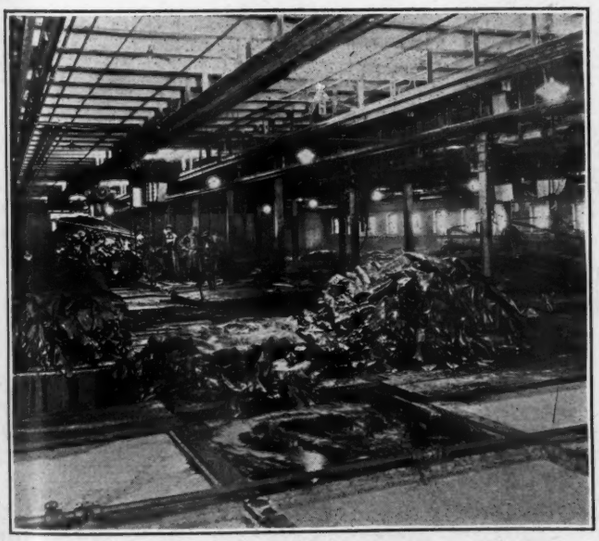


*Beam hands cleaning off surplus flesh remaining after the hides have been run through the fleshing machine.*

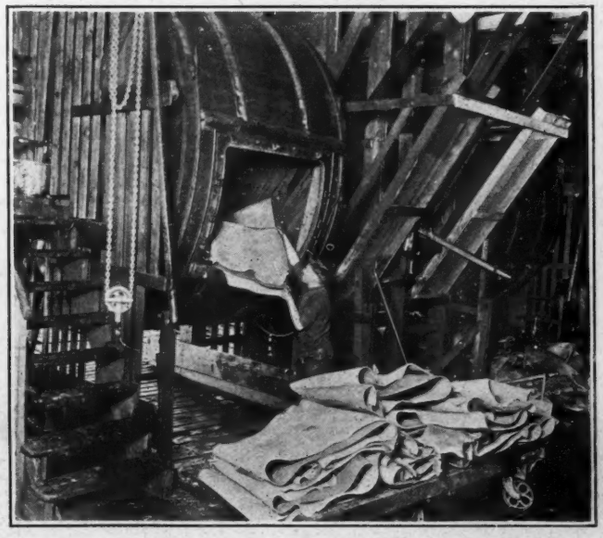
*Inspection table where hides are examined carefully before they are put in the tanning liquors.*



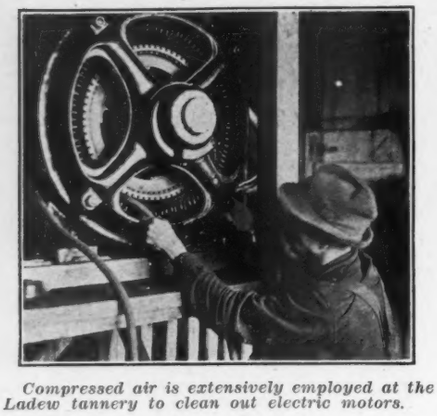
*Mixing or agitating by means of compressed air the oils used in the treatment of the leather before removing the latter to the drying lofts.*



*Layaway Yard. Hides piled down prior to laying them away in the tanning vats. Hides are shifted on the platform by means of a hoist traveling on a monorail system.*



*Drums used for the oiling of leather.*



*Compressed air is extensively employed at the Ladew tannery to clean out electric motors.*

icals restores the liquids to their proper strength for the reception of the next batch of leather. In this department of the tannery, the substitution of compressed air has been found more effective and economical than hand plunging.

At the conclusion of the bleaching, the leather is run through a wringer to free it of much of its contained water before being oiled. The oiling is done in a large revolving drum and the leather is subjected to this mechanical kneading for twenty or 30 minutes. The purpose of the oiling is to slow up the evaporation of the water still carried by the leather while the latter is undergoing drying. This check on evaporation protects the leather against surface oxidation. Before the oily mixture is pumped into the drums it is thoroughly agitated by compressed air.

When the leather has dried sufficiently, it is removed from the drying lofts—generally at the end of eight days—and is "wet back" with water to soften it so it will yield properly under big pendulum rollers. These rollers are of brass, because iron or steel must not be allowed to touch the leather at this stage lest they promote the formation of ferric tannate, which would discolor and spoil the commodity. The dampening of the leather after coming from the drying lofts causes the finished material to be somewhat more pliable, and this is needful to facilitate the operation of certain shoemaking machines. The cobbler prefers a less flexible sole leather, and for him the material is made harder. The final touch to the leather consists in polishing the "grain" or erstwhile hair surface of the hide by exposing it to the sweep of a series of cylindrical brushes.

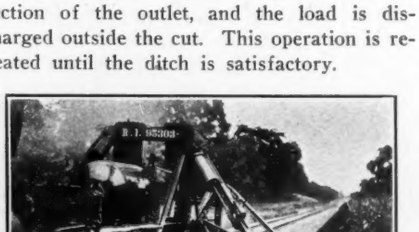
Starting with the green salted hide and carrying the operations through to readiness for shipment, the manufacture of sole leather calls for a span of fully four months. The vegetable tanning process employed at the Ladew tannery, together with the aid of compressed air as already described, produces a fine grade of sole leather which is worked into only the best of footwear, and the treatment described yields a commodity which is distinctly superior in the qualities of durability and resistance to water. Therefore, leather of this sort is especially suited for use in the making of boots and shoes that are to be worn in all kinds of weather.

In the Ladew plant, most of the apparatus are driven by electric motors, and air lines, with convenient connections, are led close to these motors so that the electrician may employ air for cleaning them and blowing out dust from inaccessible parts. Similarly, compressed air is relied upon to deal with the brushing machines, which cannot be conveniently cleaned by hand. Compressed air is utilized for siphoning liquids from barrels to the storage tanks; and the intention is to spray the fuel into the oil-burning furnaces of the steam plant by means of this adaptable medium. In short, the management of this typically progressive tannery are satisfied that compressed air is essential to efficiency and to economical operation in divers directions.

## COMPRESSED AIR OPERATES DITCHERS ON RAILWAY WORK

THE PROBLEM of proper drainage for railroads is as old as the railroads themselves. Without adequate ditches the track cannot be maintained at a high standard.

The original ditcher, a shovel in the hands of a more or less efficient laborer, is being replaced by powerful wing-type ditching machines. The wing or scraper blade is shaped to conform to the standard section of the ditch and roadbed shoulder. This wing steadily cuts the soil. It pushes it ahead to some point where it can be thrown clear of the roadbed. The ditcher wing and folding parallel retainer are lowered in the ditch at a point about two or three hundred feet from the outlet end. The train moves forward in the direction of the outlet, and the load is discharged outside the cut. This operation is repeated until the ditch is satisfactory.



O. F. Jordon Co., Indiana.

*Auxiliary wing in position to widen cut.*

The average load discharged from the wing is about eight cubic yards. It can be deposited on the fill in the form of banking to the true cross-section. By this method a true ditch is formed, the wing cutting on true lines to the railroad's standard design. The wings are handled by power equipment from the car, usually operated by compressed air from the locomotive that pushes the car. In general, the ditching is done on one side at a time, but the larger machines have wings on both sides and can clean both ditches at once.

For the best results, a heavy locomotive is used, operated at a speed of from three to eight miles per hour, according to the character and amount of material and the condition of the track.

The greatest efficiency is obtained with two wings, since the second wing eliminates much back haul of the machine. Occasionally both wings can be used at the same time, giving a balanced load which permits greater speed in safety. On the last run a steel template on the bottom of the wing finishes the roadbed shoulder, ditch and side-slope to the standard section. An average day's work is about 400 cubic yards of material moved and about 4,700 feet of ditch finished.

*Compressed air ditcher at work on Canadian National Railway at Pelley, Sask.*

## SANDS IN ALUMINUM-ALLOY FOUNDRY PRACTICE

INVESTIGATION by the Bureau of Mines, as one of the Governmental agencies directly co-operating in a general research of all foundry sands, organized by the American Foundrymen's Association and the National Research Council, is collecting data on sands for molds and cores in aluminum-alloy foundry practice.

There is pressing need of collated information on sands used in aluminum-alloy founding, and it is hoped, as a result of the investigation, to aid in disseminating knowledge on the subject. A questionnaire is being sent by the bureau to aluminum-alloy foundries in the United States in order to obtain data to be used in the preparation of a report. It is possible that some foundries of this kind are not upon the bureau's mailing list, and it is hoped that any such plants that do not receive the questionnaire will apply for one. While the replies to the questionnaire will be summarized for publication, the contents of individual communications will be held strictly confidential. Communications in regard to the matter should be addressed to R. J. Anderson, metallurgist, U. S. Bureau of Mines Experiment Station, Pittsburgh, Pa.

## LONG ROPE TRANSMISSION

A traveling rope, 23 miles long is one of the things boasted of in British Columbia. It is the "aerial tramway," 11½ miles in length, from the Premier Mine to the dock at Stewart. This tramway has a drop of 1,400 feet from loading to discharge terminals, and it cost $300,000. The rope is operated by a 60 horsepower electric motor; there are 153 towers in the line, twelve tension stations and three angle stations.

The Ford Motor Co. expects its production will reach a highwater mark of approximately 1,150,000 cars and trucks this year.

# Compressed Air in the Foundry

## Pneumatic Devices Perform Many Useful Operations in the Foundry—Reduce Costs and Increase Production

By L. W. SCHNITZER

**NUMEROUS devices have been introduced into modern foundry practise to replace hand labor and thereby increase production with less expenditure. These devices depend upon compressed air as an actuating medium and in recent years compressor installations in modern foundries have become the established rule.**

**The advantages resulting from such installations as described in the accompanying article leave no room for any possible doubt to exist as regards the advisability of using compressed air for the many different operations required in the foundry.**

COMPRESSED AIR has been used in the foundries since the days when the old hand bellows were used to blow sand out of the molds. Every modern foundry,—whether it be a steel, gray iron, malleable aluminum, or brass,—has use for compressed air; and, every modern foundry must use compressed air if it expects to meet competition.

The air compressor has not only displaced the old hand bellows, but it has also made possible the sand blast, and the use of many other labor saving machines.

These machines taken in the sequence in which they enter in the making of castings are: pneumatic hoists, pneumatic sand shakers, pneumatic vibrators, pneumatic sand rammers, jolt rammers and squeezers, pneumatic stationary motors, core busters, chipping hammers, portable pneumatic grinders.

There are two distinct types of pneumatic hoists manufactured; these are the cylinder and motor types. The cylinder hoist consists of a direct acting piston operating in the cylinder. This cylinder hoist gives good results on work where a short lift is wanted, and where first cost is the greatest consideration. However, in general foundry work where the hoist is used for handling cores and serving molding machines, it has been shown without doubt, that the motor type of air hoist is far superior to the cylinder type.

A point to consider when installing air hoists is the question of head room. With the cylinder hoist it is necessary to have the headroom equal over twice the distance of the lift. The air motor hoist will give a twenty foot lift and requires only a total head room of 24 feet. A second feature in favor of the motor hoist is that it has the ability to start smoothly, and a graduated control, which makes it ideal for foundry work.

The following are a few typical uses for the motor hoists in the foundry.

In the receiving rooms they are used for unloading and handling material. In the core room they are used for serving ovens, and because of their ease of operation they are particularly well suited to handling the most delicate cores. The fact that heat does not affect the operation of the motor hoist is the chief reason of its success when used to charge furnaces. This type of hoist operates to the best advantage on the molding floor. Especially is this true in foundries making automobile engine castings or stove castings, or in fact any foundry which goes into quantity production on one style of casting. For this type of work each floor has a motor hoist suspended from a trolley, running on a light single I-beam type crane. These hoists are used to serve molding machines and sometimes for handling ladles. A second method is to have the hoists suspended from booms or jib cranes.

Motor hoists have been used for years for stacking pots in the annealing rooms. The Northwestern Malleable Company of Milwaukee, has had two of this type of hoists in constant service in their annealing rooms for over fifteen years. Considering the length of service, the maintenance on these hoists has been exceedingly low.

There are also uses for hoists in the cleaning room for handling castings and serving tumbling barrels. In the shipping room, this hoist mounted on a jib crane proves most useful and running on a monorail it can also be used for carrying the ashes from the boiler room. With reasonable care these machines are good for years of service, and will pay for themselves many times over in labor and time saved.

### Sand Shakers, Vibrators and Rammers

Pneumatic sand shakers find their field among the smaller foundries. A shaker does the same amount of work in about half the time a man can do it by hand, but the shaker of course cannot be compared with the high power driven mixers or mills. However, for the work for which it is intended it is handy and economical.

Compressed air has made possible the use of pneumatic vibrators. This is a small machine but it plays quite an important part in the foundry. The vibrator is attached to the table of the molding machine or to the pattern, and its vibrating action aids greatly in drawing the pattern, without injuring the mold.

The pneumatic sand rammer has done more to cut production costs in foundries than any other single labor or time saving device. This is true in small foundries using two or three rammers up to the largest foundries using several hundred.

There are two sizes of pneumatic rammers designed for general foundry work. The larger size of floor rammer, weighs 22 pounds and is suitable for practically all floor work. The smaller size, or the bench rammer, weighs about twelve pounds and is suitable for large core work, bench work, and butting off when used in conjunction with squeezing machines.

These rammers are furnished with either round or flat rod and are fitted with a butt or pein. For regular floor work the round rod rammer equipped with a butt is most popular. On bench work, however, the small flat rod rammer equipped with a pein is best adapted.

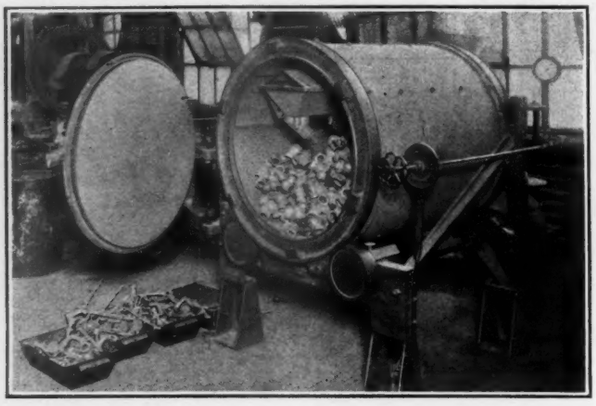
The following table of figures shows what can be accomplished with the sand rammer under average working conditions.

It is to be especially noted that these figures include not only the final ramming, but the more careful peining as well; and the total time covers the completed job. In another instance a pulley 78 inches in diameter with a 24-inch face was peined and rammed complete in three hours.

It is an established fact that sand rammers produce better castings, because it is possible to ram much harder and more uniformly, than is possible by hand.

Sand rammers are used in practically all steel foundries for dry sand work. Where green sand is used care must be taken not to

| Size of Cope | Time in Peining and Ramming | | Ratio of Reduction | Per Cent Time Saved |
|---|---|---|---|---|
| | By Hand | By Sand Rammer | | |
| 12″x 18″x 4″ | 5 min. | 1 min. | 1:5 | 80 |
| 12″x 18″x10″ | 10 min. | 1½ min. | 1:6.6 | 85 |
| 6′ x 3′ x 6″ | 20 min. | 3 min. | 1:6.6 | 85 |
| 6′ x 6′ x 8″ | 35 min. | 8 min. | 1:4.4 | 77 |
| 8′ x 6′ x 6″ | 1 hr. | 10 min. | 1:6 | 83 |
| 7′ x 3′ x12″ | 1 hr., 30 min. | 16 min. | 1:5.6 | 82 |
| 15′ x 30″x16″ | 2 hrs. | 27 min. | 1:4.4 | 77 |
| 12′ x 7′ x16″ | 2 hrs., 12 min. | 34 min. | 1:3.9 | 74 |
| 87″x159″x10″ | 4 hrs. | 40 min. | 1:6 | 83 |
| 19″x 90″x15″ | 8 hrs. | 1 hr., 30 min. | 1:5.3 | 81 |



*Sandblast barrels for cleaning small castings.*

*Battery of sand blast barrels.*

ram too hard. The fact that the operator has the number and the force of the blows under complete control of the throttle, enables him to ram as lightly or as heavily as experience dictates is desirable.

In the gray iron foundry the sand rammer is nearly indispensable, more especially on large pit work, where engine beds, cylinders, frames, and such work is cast. Imagine ramming up a 90-ton engine bed, in this day and age, by hand! Four men can do it with air rammers in about one-sixth the time it would take by hand, and furthermore, do a much better job of it.

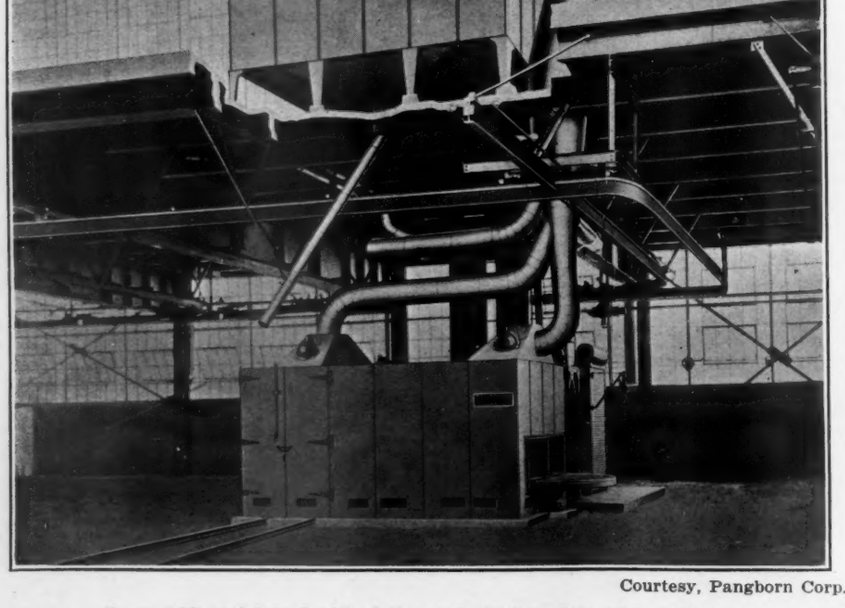
In malleable foundries the bench rammer is used to good advantage for butting off on molding machines. In one large foundry specializing on railroad work they are using a floor rammer for loosening arbors in journal boxes. This tool accomplishes this in about one-tenth the time it formerly took to do it with a sledge by hand.

Fifteen or twenty years ago the molder fought against the introduction of air rammers in their work—to-day, if the foundry did not furnish rammers for their molders, these same men who objected before, would refuse to work without them.

## Jolt Rammers and Squeezers

There are four types of air operated molding machines for foundry use, as follows: Plain squeezer machines, jolt squeezer machines, plain jolt rammers, roll over jolt rammers.

The plain squeezer machine is usually of a portable type and can be placed anywhere needed on the floor. This type of machine is best adapted for producing many small castings from the same pattern. A good operator with this machine can turn out a large quantity of molds per day. Under favorable conditions it is not an unusual thing for one of these machines to produce 150 molds for a day's run of eight hours.



Courtesy, Pangborn Corp.

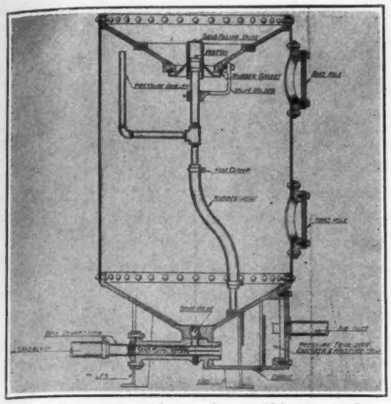
*Boom table and barrel with cloth screen dust arrester overmounted.*

The jolt squeezer machine is the same as the plain squeezer except that it has in addition an extra jolting action. This jolting action is caused by an air operated plunger, which is under the control of the operator. With this feature the mold can be jolted before the squeezer is brought into effect. Because of this jolting, larger and deeper molds can be made than on the plain squeezer. This feature of course does not prevent the machine from being operated as a plain squeezer when a lighter run of molds is being turned out.

The plain jolt rammer does just what its name implies. It rams by jolting only. Because of its ruggedness and adaptability this machine is very popular in jobbing foundries making a wide variety of castings. This machine under average conditions will ram about twice as many molds in a day, as can be done by hand with the same number of men.

The roll-over jolt rammer is the most efficient of all molding machines. This machine rams the mold, rolls the mold over, and even draws the pattern. This type of machine has been developed to make all sizes of castings, from castings weighing a few pounds up to those weighing ten tons. One of the popular smaller types is the portable machine, which can be placed near the sand pile if necessary. A machine of this type with three men is capable of turning out 175 to 200 small molds, for castings up to 40 pounds, in a day. These are also popular machines in foundries making automobile castings. Machines of this size are also used in making cores.

Roll-over jolt rammers slightly larger than the portable machines, are used for the heavier class of work. These machines are usually stationary. Machines of this class show a great percentage of time saved over hand methods. To illustrate this, there is an instance the writer has in mind, of a roll-over machine turning out twelve molds of a certain casting averaging about 1100 pounds, in a day. The best that could be turned out, ramming these up by hand, rolling over with the crane, and drawing the pattern, was two a day. This certainly represents a substantial saving. This is not an unusual case by any means, and there are doubtless many foundries, where this ratio of time saved, by using machines of this type, is even greater.



*General construction of sandblast tank machine.*

## Stationary Air Motors

There are many uses to which a stationary air motor may be put around the foundry. This applies particularly to some of the older foundries. The old foundry usually has hand operated cranes, which can be equipped with an air motor at a very small cost.

Take for instance the derrick type crane often found in the middle of the molding floor. This crane is equipped with a hand crab that takes two and sometimes four men to operate. A stationary air motor can be fitted with a pinion which will rack into the gear on the hand crab. Thus with no additional equipment, this crane can be made into a serviceable power crane and not only do the work much more rapidly but do away with the services of one or two men.

A hand operated crane which can be easily converted is the chain travel, bridge type crane. The chain hoist block can be replaced with an air motor hoist, and the crane and carriage each equipped with an air motor. This whole change can be made for a few hundred dollars.

A further use for air motors is that of operating charging trucks in annealing and core rooms. In foundries where enameling is done, the air motor is used very successfully for operating the turn-tables. These turn-tables rotate the casting under the enameling sieve.

A derrick is sometimes used in the yards for stacking castings and handling material in general. The equipping of one of these derricks with three air motors makes a very efficient and easily handled rig. One of the motors is geared to the winch and takes care of the hook. The second motor is mounted on the mast and lowers and raises the boom. The third motor operates the turn-table which controls the swing of the derrick.

It is possible to purchase a unit consisting of an air motor and winch complete with cable. This is a very compact little machine and proves itself very handy on odd jobs, such as, running elevators, hauling ashes, pulling industrial cars and so forth.

## Core Busters

The pneumatic core buster or breaker is a machine very similar in construction to a pneumatic chipping hammer. It is considerably larger, however, and consequently hits a much harder blow. This type of hammer is fitted with a retainer which prevents the steel from being shot out of the hammer. This is a very important feature as it prevents the chisel from flying out after the operator has broken through the core.

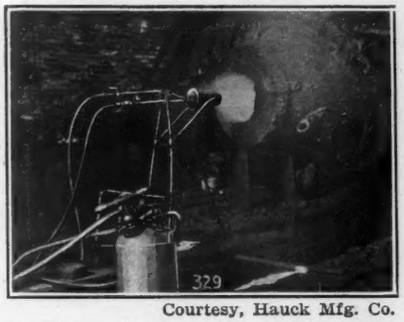
There are two distinct methods of using a core buster. One method is to dig the core out by means of a pointed chisel inserted in the hammer. The other method is to use a blunt chisel in the hammer and hold it against the outside of the casting. This sets up a vibration which loosens the core.

The cutting end of the steels or chisels for use with core busters should be finished in the shapes most suitable. For average core work the bull point steel is best adapted. On other classes of work it is sometimes best to use a flat top edge. For vibrating, the steel should be blunt. The length of the steel varies up to five feet according to the nature of the work.

Core breakers can also be used for drifting out cored holes in castings. This operation is much cheaper than reaming as it is accomplished in much less time. The core breaker comes in handy in any excavation work that may come up. It is also a great help on tearing down brick walls, ripping up cement flooring, removing concrete engine foundations, etc. This machine is one of the most useful in the foundry and very often more than pays for its cost in its first week of operation.

## Pneumatic Chipping Hammers

Chipping hammers are made in eight different sizes and great care should be taken that the proper size hammer is selected for the work that is to be done. If the chipping room foreman or superintendent is doubtful as to the size of chipping hammer to select, he should seek the advice of a reputable company manufacturing these tools, which will furnish an expert to go over his whole chipping problem with him, and recommend the proper sizes of tools to use.



Courtesy, Hauck Mfg. Co.

*An oil burner in operation drying out the lining of a converter.*

For average steel foundry work the three inch stroke chipping hammer has proved the most satisfactory. Of course a foundry having a large run of small castings will use a smaller hammer. If there is a great deal of sanding to do on the casting, the light one-inch stroke, fast hitting hammer is best suited. On chipping off fins and risers, the two and three-inch stroke hammers are used. There are few cases where the work is heavy that require the use of a four-inch stroke chipper.

In the gray iron foundry we find that the two-inch stroke hammer is more generally used than any other size. Of course there are places where the three-inch hammer is required and there are also some lighter castings that only need a hammer of one-inch stroke.

Malleable foundries making the smaller castings do not as a rule use air chippers. However, foundries doing railroad work do use chipping hammers, and the most suitable one for this class of work seems to be the three-inch stroke hammer.

Brass foundries occasionally use the two-inch hammer for chipping and also for peining the castings. Aluminum foundries making automobile crank cases and transmission boxes

*Two "Little David" hoists, No. 2, in operation in the annealing room of the Northwestern Malleable Iron Co. of Milwaukee. These hoists are used to stack annealing pots and have been in constant service over fifteen years.*

*Mold of a ninety-ton engine bed casting which was rammed up with four "Little David" sand rammers.*

find the one inch stroke chipper the best suited for their needs. For light aluminum castings the very light chipping hammer, known as the scaling hammer, is used.

In jobbing foundries where the work varies it is hard to make a comparison showing how much more work can be accomplished with an air chipper over a man using a hand chisel. It is safe to assume, however, that one man with a pneumatic chipper will do more work than three men can do with hand chisels. In shops working on one line of work such as automobile cylinders, truck axle housings, etc., it pays to give the arrangement of the cleaning room considerable thought. For instance, a man can do a great deal more work, if the casting he is to chip is placed on suitable blocks, than he can if he has to stoop over and chip a casting that is lying on the floor.

### Pneumatic Grinders

The pneumatic grinder is a portable machine sufficiently light in weight to be handled by one man. This machine is designed to take care of the work that cannot be done with stationary or swing grinders. In other words the operator takes the portable grinder to the casting instead of bringing the casting to the grinder. Care should be taken to select the proper grade of wheel for the work to be done.

By the use of specially shaped wheels these grinders can be used to clean the more difficult castings. The use of a large conical shape wheel enables the operator to clean out corners. One of the hardest castings to clean is a gear wheel. To clean the teeth of a gear with a hand chisel and hammer is a long laborious process. The easiest way to clean these teeth is with a portable air grinder. The operator can be provided with a stand on which he can lay the gear horizontally. This stand should be of such a height that it will elevate the castings to his waist. The portable grinder should be equipped with a wheel which will fit in the grooves between the teeth. However, care should be taken that this wheel does not fit too snugly. The operator will undoubtedly break a wheel or two until he gets accustomed to the work. With a little practice, however, he will be able to clean ten gears while the man using the hand chisel will do one. These machines can also be equipped with wire brushes and used for scratch cleaning castings.

### Care of Pneumatic Equipment

All foundrymen agree that pneumatically operated machines and tools are probably the greatest labor savers in the foundry. However, all foundrymen do not seem to appreciate this, and consequently a good many of their tools are neglected.

All chipping hammers, sand rammers, portable grinders, core breakers, etc., should be returned to a central tool room every night. The responsibility for their maintenance should be entrusted to a capable man, and he should see that all machines are periodically oiled and taken apart and cleaned.

Money invested in the maintenance of this equipment will be returned many times over in the form of continuous service and low repair cost.

*Sand rammer used for loosening the arbors in journal box castings at the plant of the Northwestern Malleable Iron Co., Milwaukee, Wis.*

## A DARING UNDER-WATER REPAIR JOB

The recent death of Thomas Ockerby, 89 years old, and for 30 years a pensioner of the Peoples Gas Light & Coke Co., Chicago, recalls a daring feat of which he was the hero 60 years ago.

In 1862 a steam tugboat, the *Fanny Stafford,* blew up in the Chicago river. Shortly afterward it was found that a 24-inch gas main under the river was filling with water. The valves were closed at both ends and Ockerby crawled through, bringing back with him a piece of grate bar from the *Fanny Stafford* which had been blown clear through the pipe. In order to make it at all possible for any one to enter the pipe it had been necessary to get the fire engines to first pump out the water and then pump in air. Ockerby once said the last thing he heard when he went down the pipe was the remark, "How are we going to get this fellow out if he dies down there?" William Stray, then blacksmith for the company, accompanied Ockerby on his next trip into the pipe. One of them went in feet first and one head first, so that they were head to head in the pipe. They took some short handled hammers to turn the burrs made in the passage of the grate bar through the pipe. Then by means of a bar of iron and a turnbuckle they braced a dam of rubber, lead and iron into the crack; each then crawled out of the pipe at separate ends. The job held as long as the pipe remained in service.

## OZONE FOR SEASONING TIMBER

According to a recent issue of *Journée Industrielle,* Monsieur Otto, Professor at the Sorbonne, has invented a process for seasoning timber by the use of ozone. The process is said to give the same result in about twenty days as would naturally be obtained in the course of several years. The wood is subjected to the action of a current of air containing a certain percentage of ozone. A micrographic examination made by the laboratory of the Conservatoire des Arts et Métiers is reported to show that samples of oak and walnut which had been treated by the Otto process, show the same characteristics as seasoned wood. The treatment does not change the color of the wood. The process is being worked by a French company, which has constructed works at Seregno, near Milan, and will shortly build new works in the neighborhood of Paris.

## A BILLION CANDLE-POWER LIGHT

Aerial navigation being developed so rapidly, especially as regards speed, it has become necessary to increase the intensity of the night signals. Thus far the reflectors which carry to a distance of 40 to 60 kilomètres (25 to 37 miles) have about 35 million candle power, but it has been decided to erect on the mount Afrique, near Dijon, in eastern France, a reflector giving about a million candle power and which in average climatic conditions will have a projecting capacity of 160 kilomètres (100 miles) and will be visible at more than 300 kilomètres.

# Air Used For Many Purposes at Southern Pacific Shops

By C. W. GEIGER

THE AIR pump testing department and the air brake testing and repair department of the new Bayshore shops of the Southern Pacific Railroad use a special air tank which provides the proper pressure for testing the air brake apparatus such as feed valves, brake valves, tripple and distributing valves. There is also a steam line leading to this department which supplies steam for operating the air pumps. An air hoist with a radius of about twenty feet is used for handling the pumps to and from the test racks. Facilities are such that three pumps can be attached to the testing rack at one time.

All air pump equipment is given a general overhauling at least once a year and more frequently if necessary. There is also a distributing valve test rack and a brake valve test rack for all types of brake valves.

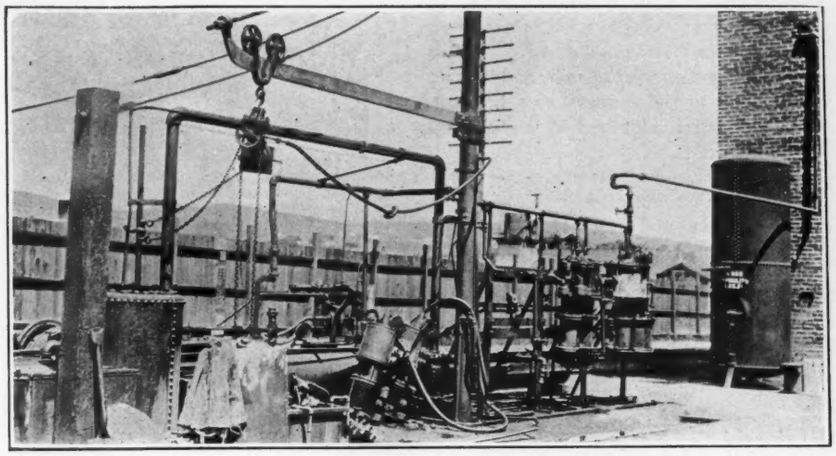
A number of valve setting machines have been built which are driven by a geared down air motor. The valve setting machine is placed under the rim of the driver to allow valves to be run over and set. The entire equipment can be set up or dismantled on short notice and gives any movement desired.

A portion of the west end of the coach shop is occupied by the coach air brake testing plant. This section is also equipped with charts and air brakes for teaching and demonstrating the operation of modern types of air brakes now in use on the Southern Pacific lines. All tripple valves removed from all cars are delivered to this department where they are repaired and tested and made ready for further service. Those that cannot be repaired are turned over to the Westinghouse Air Brake Company at Emeryville, Cal. All car inspectors of the Coast Division are required to take air brake examinations from an expert air brake man. In addition to the sketches and charts of air brakes tripple valves are provided which are cut away in such a manner that all working parts can be seen while the brakes are under operation.

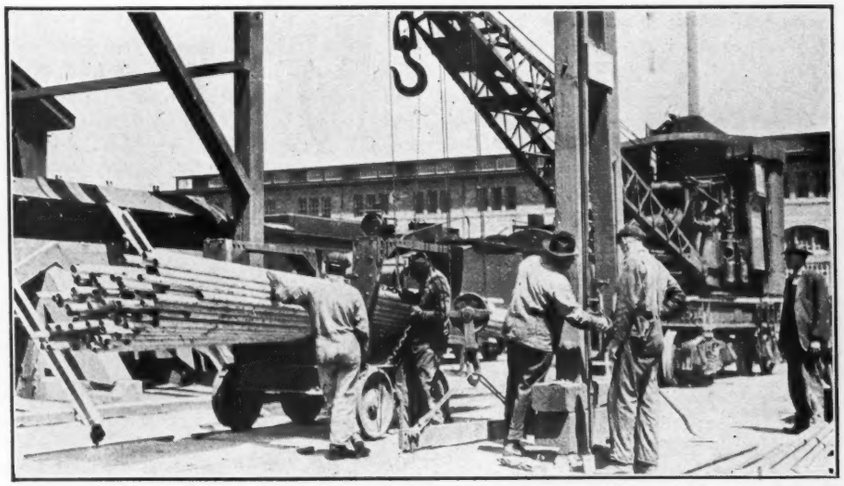
The freight car repair shop and the cripple yards are well supplied with modern pneumatic tools, including air riveters, air hammers, bolt cutters and chipping and calking guns. A two-inch air line serves this section of the shops, there being several air tanks located at various points for supplying air. Altogether there are eleven air tanks located at various points throughout the Bay Shore shops. By having these tanks located at various points a much better supply of air is received than would be the case if only one large tank was used. One of the illustrations shows eight of these individual air tanks just outside the power plant.

The main air lines through the yard leading from these air tanks are four inches in diameter.

The brass foundry and Babbit shop are served by oil burners operated by compressed air. The oil supply to all fires is supplied by



*Air pump test department showing air hoist used in handling pump to and from the test racks.*



*Man operating the air valve of an air motor for raising flues from the truck and depositing them into flue rattler.*

*The eight air tanks outside the power plant*

means of a steam driven compound plunger pump, drawing oil from an underground storage tank of 1,000 gallons capacity. The pump discharges into a two-inch pipe system extending throughout the departments. The oil is heated to the proper temperature by means of a system of steam coils, exhaust steam from the pump passing through the coils, heating the pump passing through the coils, and heating oil is delivered to the burners at a pressure of 80 pounds and is atomized by compressed air.

In the blacksmith shop there are two forging furnaces, both being oil burners, one case hardening furnace and one steel hardening furnace, which are connected up with the compressed air line, which is used in case of emergency.

The flue shop is located between the boiler shop and the round house. Flues are brought to this department by means of locomotive cranes, and also on a special truck. Compressed air is used in delivering the flues into the flue rattler. A compressed air operated motor is connected to two rails by means of chains and cables which automatically raise the flues from the special truck, and deposit them into the flue rattler, without any effort on the part of the workmen. This has a capacity of 500 two-inch flues or 75 superheater flues.

In the boiler shop there is a flanging machine which is operated by compressed air, and various other equipment including several forges. There are two three-inch air mains one in each side of the building, with 1¼-inch leads and connections at each column.

A novel gas plant perfected by one of the shop foremen adds greatly to the efficiency of the shops. Three old air drums were used in the construction of this gas plant. One drum having a capacity of about 40 gallons is used for storing the distillate or gasoline which is used in the manufacture of the gas. The gas manufacturing tank has about three times the capacity of the distillate storage tank. The gas receiver is about one-half as large as the gas manufacturing tank. After the proper amount of distillate or gasoline is delivered into the gas manufacturing tank, a valve between the two tanks is closed. A by-pass connects the manufacturing tank with the receiving tank, and from the receiving tank the gas is piped throughout the shop.

In manufacturing the gas, compressed air is passed through a superheater before it reaches the manufacturing tank. The pipe carrying the compressed air extends down into the gasoline and terminates about three inches above the bottom of the tank, and as the compressed air passes in, it stirs up the liquid creating a gas of a low pressure. As the gas accumulates it automatically passes into the receiver ready for use.

To add further to the efficiency of the gas manufacturer there is a coil heater under the bottom of both the manufacturing tank and the receiver. A safety device in the nature of a pop valve is set upon the manufacturing tank which blows off at 50-pounds pressure. This gas is piped through the shop and also to the locomotive paintshops.

## DRILL STEEL—BITS AND SHANKS

[Drill steel has always been a much discussed subject and it probably will continue to be as long as there is rock to drill and blast. We are continually receiving letters asking for advice on various phases of this subject. Most of these questions and their answers are of interest to a large part of our readers, and therefore this column is published in order to give our readers the benefit of the service that we have been rendering through this correspondence. Questions are especially invited which have to do with any phase of forging, tempering and the care of drill bits and shanks. Our answers, based on the best modern practice, will be published in succeeding issues.—Ed.].

Compressed Air Magazine,
New York City.

Dear Sirs:—I have listened to a good many discussions and have read different opinions upon the proper selection of hollow drill steels. Will you tell me just what are the points most desirable in such selection? I would appreciate your opinion. Yours truly,

Houghton, Mich. S. R.

Hollow drill steel must be free from impurities, necessitating it to be made from the purest grade of iron ore. It must be uniform in size and if hollow, the hole must be round, centrally located, of uniform diameter throughout the bar, and of sufficient diameter to allow easy access of the water tube. It must be of proper carbon content to insure the best results from tempering and oil treating.

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Compressed Air Magazine,
New York City.

Dear Sirs:—I have been heating my steels for forging bits to about 1900° F which is in accordance with instruction which I received from the manufacturer of the steel. On my tempering heat, I tried to obtain a temperature of about 1600°, and heat the steel for the same distance as I took when forging, and then quenched the whole bit in brine, feeling that by doing this I would get the best bit for my ground which is a granite. I found that my bits will chip of readily while drilling. Is it possible that I am not using proper temperatures. Yours very truly,

San Francisco, Calif. T. R.

Your forging heat is a little high if you are using the best grade of commercial drill steel. You do not say, however, how far back from the point of the bit you are heating the steel on your forging heat. This should be about ½ in. further back than where the cone of the bit joins the main body of the drill steel. You are taking too high a heat for tempering. This high heat has caused the steel to harden throughout and has produced a course crystalline grain, very hard and very brittle. This accounts for your trouble as the resistance to chipping is very small. For tempering we would recommend that the temperature of the steel, at the moment that it is dipped into the tempering tank, be 1440° F., and that the steel be heated back ½ in. further on the bar on the tempering heat, than it was on the forging heat, so that the tempering heat over-laps the forging heat and refines the grain of the steel, and that then the entire bit be quenched in brine or a tank containing clear, cool, running water, free from oil, soap suds or like impurities.

This re-heating to 1440° F. will entirely destroy the coarse grain structure left by the forging heat, and replace it with a fine grain uniform tough structure, and will have no tendency to chip. A bit tempered in this way will give the maximum service.

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Compressed Air Magazine,
New York City.

Dear Sirs:—I am using quite a large amount of drill steel and from time to time curved cracks appear on the corners of my drill bits. I would like very much to know what is the cause of this kind of cracking and also how can I prevent it. Yours very truly,

Butte, Mont. S. McN.

The center of your bit is too heavy and your corners are too slight. Machine sharpening should remedy this trouble. However, if you are sharpening by hand, use a small fuller for drawing corners of the bit and draw the metal from the center of the bit toward the corner and not from the side of the wing. If your corners are heavy and the crack appears, in all probability the heat is too high when the bits are quenched.

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Compressed Air Magazine,
New York City.

Dear Sirs:—The Questions and Answers column of Compressed Air Magazine for May, 1922, recommended that rain water be used for quenching and states that alkali water is not satisfactory. These statements resurrect the days gone by when special quenching fluids were necessary (?) to correctly harden steel.

It will be found that the hardness obtained with drill steel by quenching from a suitable temperature in water, brine, alkaline water, rain water, etc., will vary but little. If the volume of the quenching medium is small and a large number of steels are quenched in it, a different condition arises. The hardness obtained depends upon the cooling power of the quenching medium. The cooling power of water falls off with a rise in temperature of the water and over 100° F. is seriously affected. Brine at this temperature has approximately the same cooling power as at much lower temperature. This can be seen from the data of Mathews and Stagg in "Factors in Hardening Tool Steel" A. S. M. E., and which are corroborated by our own experiments. One automobile concern is using quenching baths of sodium hydroxide (alkali) in water instead of brine. Almost any kind of water will satisfactorily harden drill steel provided it is used in sufficient volume at a satisfactory temperature.

Denver, Colo. E. F.

The above letter refers to an answer to an inquiry published in the May issue discussing the proper quenching of drill steel. Further discussion from our readers is invited.—(Editor's Note.)

# The Pneumatic Placing of Concrete

## Compressed Air Solves Two Difficult Problems in the Lining of Tunnels—Particularly Adapted for Use in Inaccessible Places and Also Obviates Obstruction of Traffic

By SIDNEY MORNINGTON

"DO IT WITH compressed air: save time and money." This is not a mere business-getting catch phrase, but the summing up of many a difficult task essayed and carried through to a successful and satisfying conclusion. And probably no better examples of efficiency, excellence, and economy can be cited than what compressed air has made possible in placing the concrete lining of tunnels.

The veriest layman with only a passing interest in the modern adaptation of reinforced concrete has, no doubt, been impressed more than once with the amount of wooden forms and framework that is essential to the molding of the plastic material. And even where gravity chutes and elevators help to distribute the concrete still much manual labor is commonly required to spread and to properly dispose of the fluid mixture. The "green" concrete must be well supported and held firmly in position until it has "set" and solidified sufficiently to stand alone. All of this preamble is by way of laying the foundation for a proper understanding of the part played by compressed air in handling concrete and in getting it into place where the contractors could not have over-much elbow room or recourse to the usual scaffolding, etc.

Ten years ago, the Pittsburgh and Shawmut Railroad drove a tunnel 2,000 feet long through the hills a little more than 100 miles to the northeast of Pittsburgh for the purpose of facilitating a heavy coal traffic. The tunnel passed right through shale, soft earth, and numerous veins of coal; and to prevent any subsidence of this uncertain geological formation, the builders resorted to heavy timbering and a sheathing of three-inch planks. In the course of time, ground water and the gases from the belching stacks of freight and passenger locomotives caused deterioration; and the protecting woodwork rotted to such an extent that it became necessary to substitute a concrete lining. This was taken in hand during the World War, but for military reasons secrecy was maintained.

In deciding to reinforce the timber structure of the Coulter Tunnel with a lining of concrete it was essential that methods be used that would not block traffic. Therefore, facilities had to be provided that could be run in and out of the tunnel quickly and which would occupy the single track only for short periods. This meant that adjustable steel forms had to be relied upon to bear the load of the concrete during molding and hardening, and they were arranged to be run into place or removed through the aid of suitably-equipped platform cars. When the molds were detached from the platform cars, and the latter were drawn out of the tunnel and shunted onto a convenient siding, the arched forms left the right of way clear. The bases of the forms rested upon their own wheels which rolled upon special broad gage tracks that paralleled and lay outside of the regular service rails.

By way of preparation, the inner faces of the existing timbers were sheathed with seven-eighths-inch tongue-and-groove boards which were overlaid on the inside with three-ply paper and a waterproof coating of tar. The spaces thus left between the bents and the sheating were filled with gravel. This allowed the easy movement of any water that might work its way through the original tunnel lining and, incidentally, made sure that that seepage should be led to drains by which it could flow toward the tunnel portals.

The next step was to run in the Blaw collapsible steel forms, of which there were four—each 30 feet long. When a form was in place there was between it and the waterproofed lagging an average interval of two feet; and the object was to charge this solidly with concrete and so mold the permanent lining. As soon as a section had set, the form was removed and advanced to the next operating point, where it was adjusted anew. Up to the springing line, the form frames were plated with steel, and above that line they were covered with detachable planking. The slight collapse of the molds needed to break contact was effected by the simple withdrawal of a key at the crown and by the action of a threaded portion of the axles of the sustaining wheels which induced the side walls of the forms to pull away from the recently-cast concrete.

The concrete for the entire task was mixed in a Ransome-Caniff pneumatic mixer which was installed at one side of the track just outside the tunnel. This apparatus had an hourly capacity of ten cubic yards; and the concrete was delivered through a six-inch steel pipe which had a single bend of 22 degrees. The metal conduit was 2,000 feet long when fully assembled, and at the discharge end there was connected a 30-foot length of rubber hose. This hose made it possible to guide the outpouring concrete to any desired part of the space to be filled. Work was started at the portal of the tunnel remote from the mixing-and-placing plant, so that the journey of the concrete was progressively shortened with the casting of each succeeding section of lining. During the full run of about 2,000 feet, the concrete traversed the interval in approximately 90 seconds, and the impulse energy was compressed air at a pressure of 80 pounds. The engineer knew that the batch was delivered as soon as the gage on the line dropped to 45 pounds, and then he immediately throttled the air to avoid wastage. The power house was equipped with two Ingersoll-Rand air compressors of 1100-ft.-per-minute capacity.

The concrete did not wear down the contact surface of the steel main, nor was the rubber hose materially damaged when the concrete passed through it at a distance of 500 feet and less from the pneumatic mixer; but this

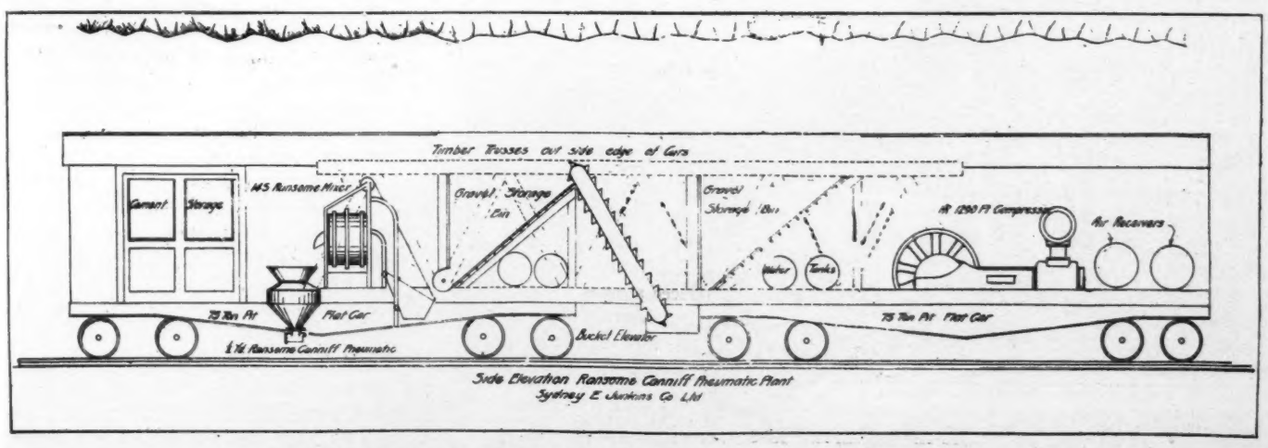


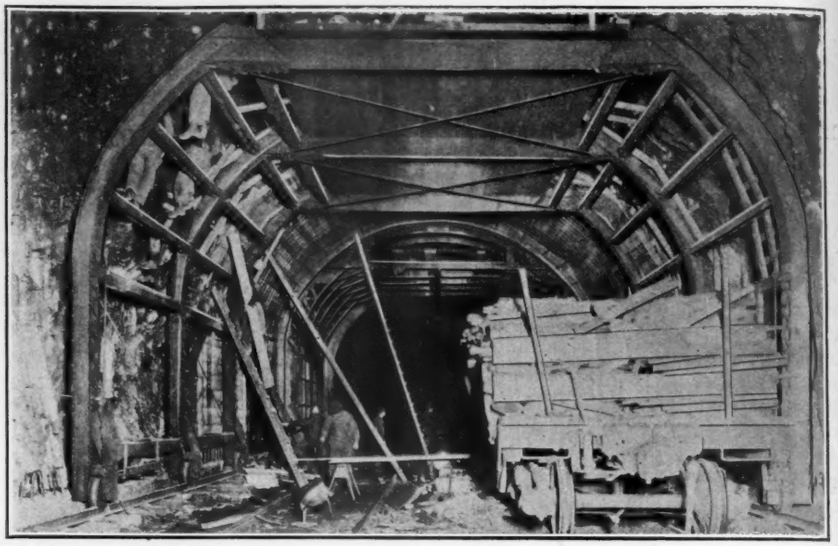

*Diagram of the two-car unit used in lining the Connaught Tunnel with concrete.*

flexible conduit was noticeably affected when the concrete was conveyed a longer way.

By means of a baffle placed in front of the hose outlet, any tendency of the aggregate to segregate was checked; and the fully mixed material was delivered in a uniform condition to any portion of the tunnel circumference and, therefore, no spading or tamping was required.

As soon as a form was filled on both sides up to a height of about nine feet, a steel nozzle was attached to the discharge end of the rubber hose, and, with the added velocity thus obtained, the stream of concrete was forcibly directed into the cavity until the space was solidly packed. Finally, the keying of the arch was accomplished by closing the crown of the transverse bulkhead with the exception of a circular passage into which the nozzle fitted snugly. A concluding batch then sufficed to fully charge the remaining recess. The lining progressed at the rate of 120 linear feet a week, the men working daily in two ten-hour shifts. The forms were held in position for 48 hours; and upon their removal the surface of the concrete was so smooth that no after treatment was needed. Before being used again the folds were scraped, washed, and oiled to insure proper stripping at the next application. The pumping or plunger action of passing trains and the frequent exhausting of compressed air together served to keep the atmosphere in the tunnel clear enough for the operatives to carry on without much inconvenience.

Probably the most interesting employment of the penumatic mixing and placing of concrete is that in connection with the lining of the Rogers Pass or Connaught-Tunnel on the main line of the Canadian-Pacific Railway. For the sake of those not familiar with this double-track, five-mile passage piercing the Selkirk Mountains of British Columbia it should be said that the tunnel was constructed primarily to shorten the previously followed route by nearly four and a half miles and, at the same time, to dispense with four miles of snow sheds which had entailed an annual outlay for maintenance of substantially $25,000 a mile. Construction was begun in 1914, and the tunnel was ready for service in the closing month of 1916. The bore passes right through Mount Macdonald, taking a generally southwest direction from east to west—the western portal being close to the town of Glacier. The tunnel is 4,000 feet above sea level; and, being 220 miles away from the nearest city, the housing of the force, getting a plenty of men, materials, and equipment, have involved special problems.



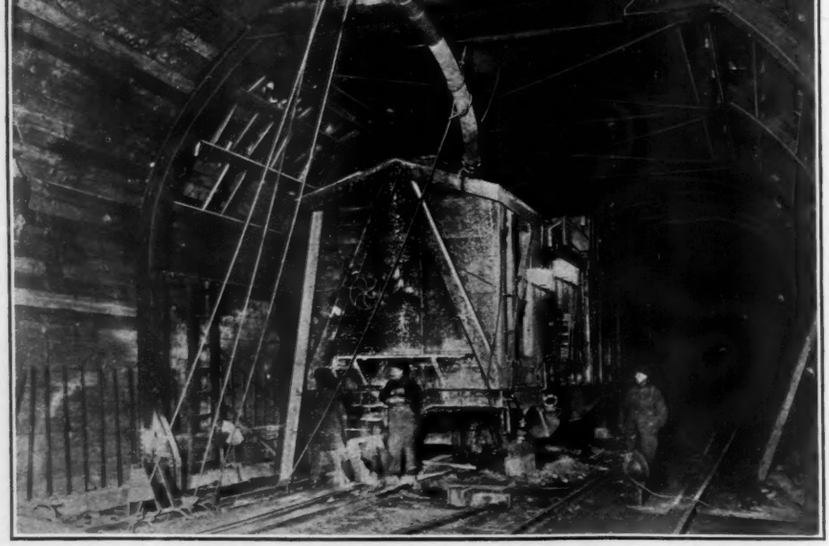
All photos furnished by Courtesy of Ransome Concrete Machinery Co.

*A close-up showing the placing of the reinforcing bars and the men at work making other preparations for the molding of a section of the tunnel lining.*

In piercing the mountain, the rock encountered consisted principally of schist and lesser veins of slate and quartzite. Because of the prevalence of schist and quartzite it was believed at first that it would be unnecessary to line the tunnel except in a few places, probably where slate was encountered, through which seepage occurred. Therefore, something like 20,000 linear feet of the bore was in the rough pretty much as the drilling and blasting had left it. The short cut had not been operated a great while before moderate rock faults were noticed at several points. These might not have warranted apprehension but for the tremendous mass of the overburden of Mount Macdonald; and it was feared that this pressure would eventually lead to larger crevices and the dropping of dangerous bodies of stone. As a precautionary measure, the responsible authorities of the Canadian Pacific Railway decided to line the tunnel with reinforced concrete. It was, however, of the greatest importance to achieve this without obstructing traffic.

As has just been said, the Connaught Tunnel is a prime link in a route that spans the continent from the Atlantic to the Pacific, and over that section of the road is run daily a goodly number of important passenger and freight trains. It was therefore essential that any plan for the lining of the tunnel should leave one track clear; that care should be taken to see to it that nothing interfered with the signal and other functional circuits; that the fire hazard should be reduced to a minimum; and that the means employed should insure reasonably rapid execution of the job. Without dwelling upon the disappointments and the unsuccessful efforts incident to the earlier attempts to line the tunnel and meet, the while, the conditions imposed by traffic requirements, it will serve the present purpose merely to say that the task for a time was abandoned.

Two years ago, the subject was turned over

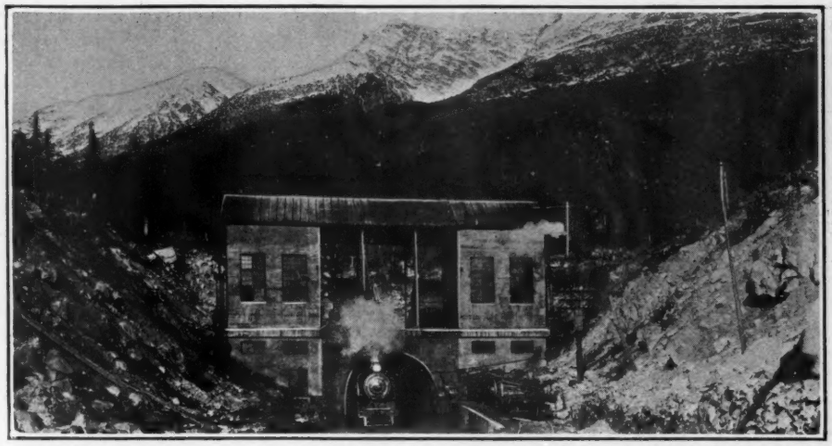


*The mixing and placing unit in action. The six-inch hose leading from the Ransome-Caniff pneumatic placer to the top of the concreting form, behind which it is steadily discharging the plastic material. At the right-hand corner of the car are visible the blocks beneath one of the sustaining jacks.*

to the Sydney E. Junkins Company, Ltd., of Canada, for consideration, and Mr. Junkins and his engineer, Mr. John D. Isaacs, after exhaustive investigation, concluded that the work could best be done by the pneumatic method of concrete placing. Inasmuch as concrete cannot be efficiently distributed by pipe from the pneumatic mixer for a greater distance than half a mile, it was evident that the procedure employed in the case of the Coulter Tunnel could not be resorted to in lining the Connaught Tunnel. That is to say, the mixing plant or plants could not be established outside the tunnel, and, accordingly, it was indispensable that the mixing and placing apparatus should be mobile and capable of being shifted anywhere within the bore.

Before beginning the handling of the concrete *in situ*, the engineers were obliged to provide a suitable central station just outside the Western portal and adjacent to the Illecillewaet River. That electric plant now furnishes current for the illumination of the tunnel by means of powerful flood lights, each of 500-watt capacity; for the operation of big ventilating blowers; for the driving of the air compressors; and for the functioning of other machinery. The primary distribution of the 2200-volt alternating current is effected by two three-phase circuits, and this is stepped down to 550 volts for power purposes and to 110 volts for the lighting system. It so happens that one of the pioneer tunnels, seven feet by eight feet in cross section, used originally in the moving of spoils and materials, lies parallel to the main bore for a span of 9,000 feet. This smaller passageway is connected with the main tunnel at intervals by crosscuts; and as far as the pioneer tunnel permits the high-tension transmission lines are strung within it. Besides avoiding to this extent the running of these conductors in the main bore, the flanking cut has made it safe to employ bare wires instead of the much more expensive lead-coated cables.

In climbing through the Connaught Tunnel, the locomotives have to negotiate a one-per-cent grade, and the smoke generated is therefore dense and voluminous. But for the blast of the blowers and the flood lights it would be a matter of many minutes before the atmosphere could be cleared sufficiently for the workmen to continue their labors, especially in the upper part of the tunnel. The lights are portable and their beams can be directed so as to deal with any situation; and these lamps have been instrumental in greatly reducing losses incident to enforced idleness.



*A train issuing from the Rogers Pass or Connaught Tunnel which pierces the Selkirks through Mount Macdonald.*

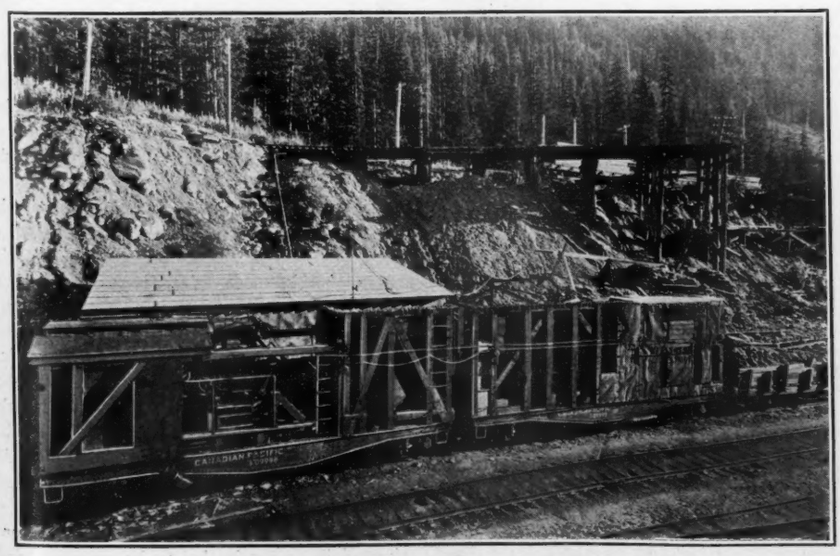
The mobile concrete-mixing-and-placing outfit consists fundamentally of two 75-ton pit flat cars coupled together and carrying certain operative apparatus that make the whole equipment a self-contained unit, capable of blowing one form or section of lining in the course of a day's work. Each car is about 37 feet long, and the complete unit has an overall length of substantially 78 feet. On one car is installed a 1290-foot Canadian Ingersoll-Rand P.L.B.-2 cross-compound air compressor, belt connected to a 200-horse-power, 550 volt Canadian Crocker-Wheeler motor. Nearby are located two air receivers, each three and one-half feet in diameter and eight feet long, together with the usual accessories.

Immediately forward of the compressor is a sand-and-gravel bin of heavy frame construction with a slanting bottom covered with light steel plating. Beneath the floor of this bin are placed a couple of cylindrical water tanks. A gate at the lower end of the gravel bin discharges by gravity onto a bucket elevator, which conveys the aggregate to a similar bin at the rear of the car ahead. The second bin is equipped with a full-batch discharging bin-gate which empties into a sliding pivot hopper, and the latter lifts and dumps its load into an electrically-driven half-yard Ransome mixer.

After an interval of a minute, the mixer pours the concrete into the Ransome-Caniff placer, whence, under an impulse of air at 80 pounds, the concrete is driven through a six-inch flexible conduit to the desired point of deposit. The forward end of the second car is devoted to the storage of cement. This compartment can hold about 400 bags of the material.

The four water tanks under the two sand-and-gravel bins have a combined capacity of 3,600 gallons. These tanks are interconnected, and a small pump near the compressor delivers this water wherever it is needed. Flexible hose connections between the cars permit this interchange as well as the distribution of the compressed air. The cars are provided with a total of eight 35-ton jacks which are hung underneath the sills. When the placing unit has been lined up for service, blocks are set under the jacks and sufficient pressure applied to raise the weight of the cars from the springs. The jacks thus take the load and constitute stable supports which effectually absorb all vibration and prevent the cars from rocking when the compressor is developing a working pressure of from 80 to 100 pounds. As one of the illustrations shows, the motor-and-compressor compartment is carefully housed over to protect the apparatus from the weather and from the dust and dirt due to the handling of cement, etc.

Under normal conditions, the pneumatic concrete placer is capable of disposing of twenty cubic yards of the material hourly, but this is not practicable in the present case owing to the gas and smoke from passing locomotives. Only two men are needed to look after the mechanical mixer and the pneumatic placer. The concrete is blown in behind Blaw-Knox collapsible forms made up of steel members and plates.



*The two-car unit employed in mixing and placing concrete for the lining of the Connaught Tunnel.*

*Running a form into the tunnel. At the left, between the rails, can be seen sections of the steel pipe used in conveying the concrete from the pneumatic placer to the points of application.*

Each form is 21 feet long. The concrete is reinforced with five-eighths inch square bars conforming to the tunnel arch and spaced one foot from center to center. Round bars one-half inch in diameter are set parallel with the longitudinal axis of the tunnel and at intervals of two feet. About three cubic yards of concrete are required per linear foot of the right of way.

A form is put in position for molding by being pushed along on special wide gage tracks until one end of it abuts with a finished section of the lining, where it is anchored or blocked pro tem. Before the mold is thus stationed, a foundation course or footing of concrete is laid on each side of the tunnel, and the superposed lining is bound to the footing by a keyway. The forward end of the form is sealed or boxed in by a bulkhead of planking. When everything is ready, the six-inch hose is alternately shifted from right to left of the mold until each encased side is filled with concrete up to the haunches or curve of the arch.

With this done, the hose is shoved back over the form as far as possible, and the concrete is blown in under full pressure. As the space fills up the hose is gradually withdrawn until its nozzle is near the bulkhead. A final batch serves to complete the keying process. The key of the arch is, naturally, the most important point of the structure; and all too often, where the concrete is hand placed, the key becomes the weakest portion. Comparative tests have disclosed that concrete mixed and distributed pneumatically will sustain 800 pounds greater pressure per square inch than hand-placed concrete. It is also reported that concrete can be prepared and disposed of pneumatically at a cost approximately 60 per cent. less than when the work is done by mechanical mixers and shovelled manually.

The contractors used six collapsible forms in the present undertaking. A 27-ton gasoline locomotive was the utility dray horse, and this tractor was decided upon as likely to be the least expensive and the most efficient machine for hauling material cars, derrick cars, lunch cars, and the mixing-and-placing equipment. This locomotive can draw 210 tons up the one-per-cent. grade and it can be controlled by a single operative. The exhaust from this engine occasioned no trouble whatever. The prosecution of the big job went steadily forward without a hitch, and there is every reason to believe that the lining will be finished well within the specified time. Recourse to compressed air has enabled the engineers to overcome numerous difficulties and has permitted them to push forward at a rapid rate, considering the circumstances under which the task had to be carried on.

It is interesting to note that it is the purpose of the Japanese to employ the same system of concrete mixing and placing in tunnel lining on an extensive scale.

## "BENDS" VICTIMS RECOVER IN AIR TANK

THE "SAND HOG," the toiler who delves under air pressure of abnormal degree in the construction of sub-aqueous tunnels or in mine shafts with tons of earth and stone and perhaps a river or a bay over his head, is safer than he formerly was in similar operations. Health hazards which at one time were regarded as inherent in the occupation of shaft sinking and tunneling under the high air pressures necessary to keep back the water in wet ground and quicksand, have been greatly reduced. Observations made by Dr. Edward Levy, consulting physiologist of the U. S. Bureau of Mines, during the progress of tunnel work in and about New York City, indicate that the methods employed there have become so systematized and improved as almost to eliminate severe or fatal cases of compressed air illness.

The illustration shows Torres Olson, a diver, who was seized with the "bends," caused by working 85 feet under water, on a sunken barge at New London and was rushed to the U. S. S. *Falcon* lying off the Brooklyn Navy Yard for special treatment.

The *Falcon* is the headquarters of the diving school of the United States Navy, and has in effect a system of treating sufferers from "bends," or "caisson disease," caused by long subjection to air under high pressure. Aboard the *Falcon* is a compressed air chamber in which patients again are subjected to compression.

Olson was suffering from paralysis of the legs, believed to be due to a bubble of nitrogen gas expanding in the spinal fluid, or in the drain, after suddenly coming to the surface. Quick return to a compressed air chamber usually causes such bubbles to break, thus curing the "bends," but a long and difficult course of treatment usually is needed in the case of those who are not treated immediately.

International.

*Compressed air tank at Brooklyn Navy Yard for treatment of patients afflicted with caisson disease.*

The tank filled with compressed air quickly relieved the paralysis in Olsen's legs and he is shown in the illustration looking out of the chamber after his recovery.

It has been found by a number of experiments that a worker suffering from compressed air illness should be put in a medical lock and the pressure rapidly raised to that in which he had previously worked. It is a good policy to keep the patient at this pressure for a short time in order to be sure that the bubbles of nitrogen have been thoroughly compressed and again taken up by the circulation. The patient may then be placed in again by the stage method, except that now the time should be double in every part of the operation. Although symptoms are frequently relieved before the pressure in which the man had worked is reached, it is safer to attain the original pressure before decompressing.

Long before any great American projects requiring the use of compressed air were undertaken it was recognized that recompression was the correct treatment for compressed air illness. Experiments of previous observers have shown that when a frog was put in a chamber of air and compressed, then rapidly decompressed, a light thrown on the web of its feet and the circulation observed under a microscope, bubbles of air were visible; when the pressure was again raised to its previous height the bubbles were seen to grow smaller and disappear. These observations of a previously known physical condition indicate that recompression is the logical treatment, and to obtain the best results it must be done before the bubbles of nitrogen can permanently injure the tissues.

## NOW SUCCEED IN PRODUCING UNBREAKABLE GLASS

ACCORDING to recent reports, a Bohemian inventor, after thirteen years of research, has succeeded in producing unbreakable glass. At a recent demonstration, it is said, plates and vessels of the material remained whole when thrown to the ground from a height of twelve feet. Meat was roasted on a thin glass plate over an open fire at a temperature of 750 degrees Fahrenheit. Tin was melted in a glass pot, and nails were driven in a piece of hardwood, using a piece of glass for a hammer. A thin glass tumbler was heated in a stove to such a temperature that wood placed in it was charred to ashes. The glass not only stood the heat, but even remained unbroken when plunged into cold water while still in an overheated condition, says *Popular Mechanics*. The carborundum stones used for cutting ordinary glass cannot be used on the unbreakable glass, as even a diamond sometimes fails to cut it, due to its extreme toughness.

# Compressed Air For Cleaning Gas Piping

## High Pressure Air for the Removal of Stoppages in Gas Lines Has Proved to be the Most Practical and Most Generally Adopted Method

By J. T. GRIFFIN

Consolidated Gas, Electric Light and Power Company of Baltimore.

**MUCH trouble and expensive repairs are often caused by the collection of foreign matter in consumers' gas lines causing the flow of gas to be retarded with the result that distribution is irregular.**

**Damp cellars are a prolific cause of rust stoppages as well as piping exposed on walls, or in general it may be said that wherever extreme atmospheric conditions are to be encountered stoppages are of frequent occurrence.**

**Compressed air has proved to be an effective agent in remedying this difficulty and after continued use has come to be the recognized method employed for removal of these stoppages.**

IN THE distribution of gas through the customers' piping, the flow is often retarded by foreign matter which, in our language, is characterized as a "stoppage."

These stoppages are principally due to a formation of rust. This rust is brought on by local conditions, which are conducive to its creation. In many instances, the stoppage has been found to be dry and loose while in other cases it has been damp and packed. The latter case is caused by a considerable amount of moisture. As a rule the stoppages by rust can be traced to locations where the cellars are damp and the piping exposed on damp walls or to extreme atmospheric conditions.

Stoppages may also be caused by pipe compounds which clog the interior of the piping. This is due to the use of piping compounds on the threads of the female fitting instead of on the male fitting, with the result that when the male thread enters the female any excess compound is pushed ahead of the male fitting and becomes a hardened mass thus making it one of the most difficult stoppages to remove. It is most prevalent in the smaller size piping and in numerous instances it has been necessary to replace the affected fitting with a new one.

At the present time, the most practical and general method of removing stoppages is by compressed air. In lieu of the use of compressed air, many companies resorted to the use of vacuum cleaners and suction pumps, but this method was not found to be as effective as compressed air and, therefore, it was abandoned.

In order to elucidate on the operation of compressed air, it would be well to define the operations of the two methods used; as, low pressure and high pressure.

### Low Pressure Method

The low pressure method is by means of a compression pump operated by hand and so constructed that the compressed air is stored in the compression chamber. (See Fig. 1). The construction of this compression chamber does not permit the air to be retained for any considerable period of time but must be used immediately. To obtain the best results, it is necessary that the air compressed be of sufficient volume and pressure. The volume of air should be such as to provide a continuous flow and the flow of this volume should be of considerable force.

These essential points were lacking in the operation of the compression pump, as tests of this method have shown that the maximum pressure obtained ranged from 60 to 80 pounds, the variation being dependent upon the physical ability of the operator. Hence the volume and pressure were not continuous but intermittent, depending upon several rechargings with the result that when the rust started to move it would be propelled only as far as the force of the charge would permit and upon subsequent recharges the same action would be encountered. The operation was effective in about 70 per cent. of the general cases where it was used.

In cases where the piping was in a straight run or in cases where the amount of accumulated rust was not of a voluminous proportion, its operation would produce satisfactory results, but in cases of long runs of piping of the one and one-half inch or two inch sizes, two or more pumps were required to be used as a battery. Where the rust was encountered in large quantities the intermittent charges would gradually cause it to be deposited in some point of the piping which would then be closed off by the accumulated mass, with the result that repeated charges would have the tendency to compress this mass into a packed formation.

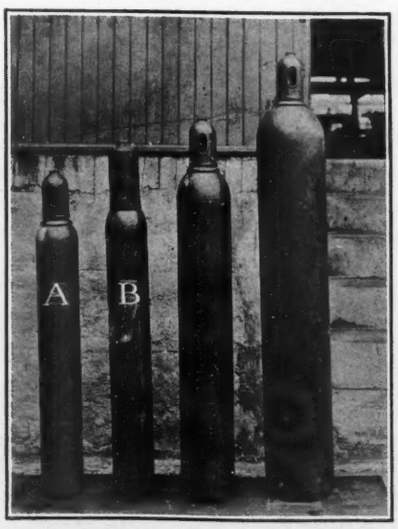



*Fig. 1—This shows several sizes of tanks, the largest of which clears an average of six to eight stoppages.*

Our experience has taught us that this would occur in about 30 per cent. of the cases, hence it was necessary where the piping was concealed to take up the floor, cut the pipe and insert a wire known as a "fish tape" in order to break this formation into such particles that could be dispelled by further use of the pump.

### High Pressure Method

The high pressure method is by means of a portable or stationary compressor and is at present producing the more efficient results of the two methods. It is gradually becoming general in its use. This is evidenced by the answers received to a questionnaire which the writer issued to several gas companies regarding the method in use and also from requests made by various gas companies for data on the high pressure method being utilized by our company.

At first there was considerable apprehension concerning the use of this method on account of the possibility of creating leaks by the excessive pressure discharged into the piping systems and fixtures. To offset this, we felt that if we could obtain results without damage in 70 per cent. of the cases with a maximum pressure of from 60 to 80 pounds by intermittent operations of the low pressure method, greater results could be obtained by a continuous flow at the same pressure. It should be borne in mind that the air is discharged from the tank through a very small opening in the form of a jet and when expelled into the piping it expands and occupies a larger volume at a pressure which is reduced to the same proportion as the volume is increased. Therefore, the amount of pressure to which the piping is subjected would be conveniently and safely controlled by the tank valve or reduction gage. This fact is corroborated by the statements of various companies to the extent that it requires from 50 to 100 pounds pressure to remove these stoppages.

It is further felt that in the event of the pressure backing up the lateral pressure against the interior of the pipe or fixture, it would be of a few seconds duration and would not have the same effect as if confined to a greater extent of time.

Various types of cylinders and containers are used as storage receptacles for the air; such as, water boilers, steel drums and acetylene gas tanks wherein the maximum pressure ranges upward to 250 pounds. One company uses auto trucks equipped with a rotary com-

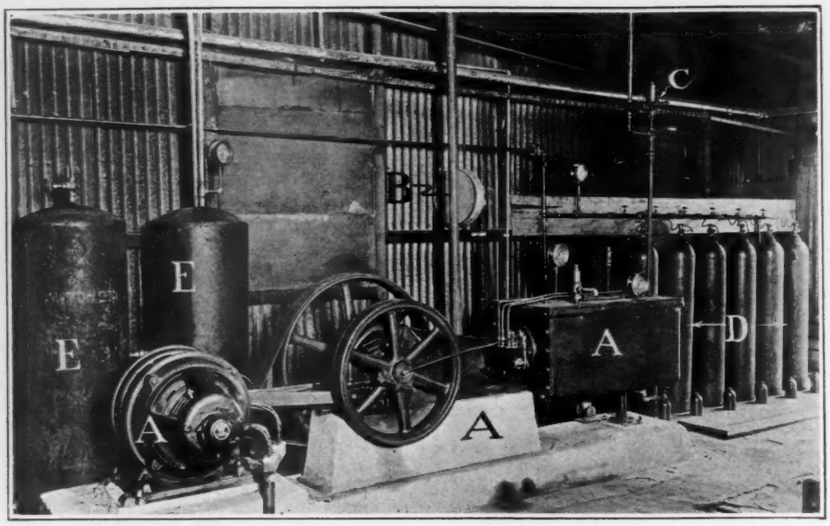



*Fig. 2—(A) An Ingersoll- Rand compressor and motor. (B) Air strainer on inlet of compressor. The object of this is to prevent particles of dust or dirt being forced into the tanks. (C) Safety blow-off valve. Set to operate at 1,600 pounds pressure. (D) Six tanks connected to manifold. Each outlet on the manifold is equipped with one-half inch high pressure valve. All pipes, fittings and valves used are constructed to withstand 3,000 pounds pressure. (E) Tanks in which air is compressed for blowing shop whistle.*

pressor driven by the truck motor. The storage container for the air has a relief valve set at 100 pounds. This method has been in operation since 1918 and from reports has produced excellent results. Several companies use from five to 40-gallon galvanized water tanks tested to withstand from 150 pounds to 200 pounds pressure. Other companies, including our own, use the standard oxygen cylinder wherein the maximum pressure ranges from 1,000 to 2,200 pounds and weighs from 40 pounds to 165 pounds each.

Several of the companies using high pressure air have the cylinders equipped with regulators to reduce the high pressure to the desired working pressure. This method has very good features, in that the amount of pressure discharged is controlled by the regulator and will eliminate the possibility of any danger through careless handling on the part of the workman.

In cases where regulators are used, the tank is generally connected to the piping by a high pressure hose. Other companies do not use regulators but depend upon the skillfulness of the operator and in such cases an iron pipe connection is made to connect the tank to the piping. The fittings on this connection are made up hand tight.

If back pressure builds against the stoppage, it can be noted by the sound of the flow and by the hissing noise caused by the air escaping. The duration of time for such charges is about three to five seconds, and is given repeatedly until the stoppage is removed or there is an indication of a back pressure. Good results have been obtained by the use of both methods.

It must be considered that the character of any work depends entirely upon the efficiency of the employee engaged in the work. This holds good in the application of compressed air and the secret of its success is attributed to the skilfulness of the workman.

In several cities where compressed air has been used, it has been noted that the companies producing oxygen have placed compressed air on the market. This is found to be economical, because in some cities the amount of compressed air used by the company does not warrant the installation of this equipment. The equipment shown in Figs. 2 and 3 is so arranged that the operator of the compressor is in a position to perform other duties while the compressor is working.

It will be noted that over-charge pressure is provided for by the use of the automatic cut-off and safety blow-off valve.

## Method of Operation

After the stoppage has been located, the meter is disconnected and a bag tied around the bottom of the outlet connection. See Fig. 4. This bag is of an ordinary cement bag type and before using it, it is dampened with water to prevent any possibility of the dry particles of rust being forced through the meshes of the bag which, if they are, would leave a gaseous odor on the premises.

The high pressure tank is connected to the nearest outlet beyond the stoppage. This outlet is created by disconnecting the fixture or appliance and the tank connected by means of a ⅜-in. iron pipe. See Fig. 5.

The essential feature in releasing the air is that it must be released gradually and with a continuously increasing flow. This is controlled by the operator and in no case should it be intermittent, as in the case of the bell pump. The success of this operation depends entirely upon the manner in which the air is applied and the possibility of creating any leaks or damages to the piping or fixtures due to the high pressure which is minimized by the intelligent care on the part of the operator who is manipulating the tanks. When the air is first released into the piping, it expands, on account of it being thrown into a larger diameter, and the pressure decreases considerably. Hence as it strikes the stoppage this pressure builds up air until the power of resistance caused by the stoppage is overcome thereby breaking it into small pieces or starting to move any matter which may be in its path until it is dispelled into the bag, at the outlet of the piping.

Of course, there is always a possibility of choking the pipe in the event that too great or sudden a charge is given. This happens principally in small size piping where the diameter is not sufficiently large enough to pass the accumulated formation. When such a condition arises, the observing tank operator is always warned of its existence, as the air going into the pipe makes a noise and the action of the air against the stoppage can be noted, for when the stoppage is released there is a sort of swishing noise as the confined pressure is released by the giving away of the stoppage.

In the event of the stoppage not being removed, there is a noise which indicates the building up of pressure in the line. This is a warning that the stoppage still exists. This can be noted in cases where there are relief valves on the tank connections and in cases where the connections are made hand tight. When a stoppage of this character occurs, the tank is transferred to an outlet in front of the stoppage. This will have a tendency to release any packed formation which may be deposited in the fittings. In such cases the pipe or hose connection is made from an outlet to an open window, in order that the rust may be blown into

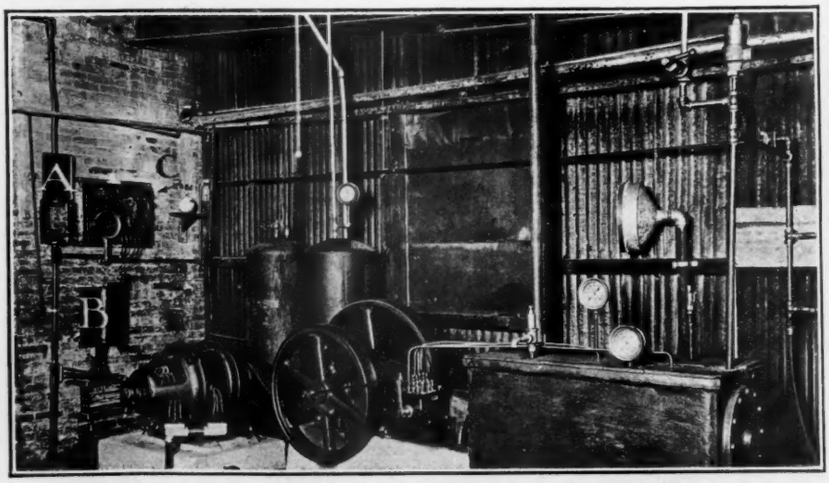



*Fig. 3—(A) Electric switch. (B) Electric motor starter. (C) Automatic electric circuit breaker, set to stop motor when pressure in tanks and manifold reaches 1,500 pounds.*

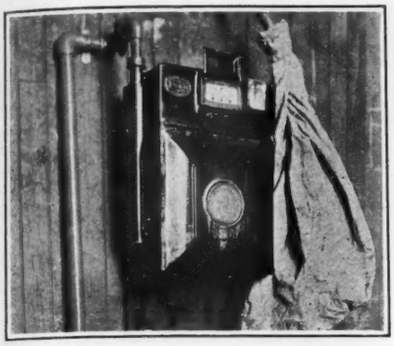


*Fig. 4—This meter is disconnected after the stoppage has been located and the bag is tied around the bottom of the outlet.*

the open. Results have shown that we have been able to clear a stoppage from a pipe in 98 per cent. of the cases.

With the view of economizing on the gas bills, consumers have placed many gas saving devices in the pipes and we have found interesting conditions upon examining the stoppages when efforts to clear have failed. In one case when cutting the pipe, a marble was found; in others, pieces of rag, wood, sponge and in one bad case we found a small flag pole about five feet long and about ¾ inch in diameter.

Many of the packed stoppages are porous, and once an opening is created the effect of the rust as it is gathered up by the flow of air is practically of a sand blast nature. It has also been noted that this sand blast effect will cut out any piping compound stoppages that may be on the interior of the piping. The best results are obtained when after charging the stoppage, a full purging charge is given which will thoroughly clear the line of any fine particles of rust. Experience has shown that these particles would be carried by the pressure of gas, after it had been connected to the piping, and become lodged in the gauze or orifices of incandescent lamps or burners.

Many of the companies remove all gas fixtures to avoid any possibility of them becoming clogged. Other companies removed the lamps after the gas had been connected to the piping and by opening the fixture keys removed any fine particles that would possibly remain. The latter system is more generally used.

We originally compressed the air to 1,000 pounds and subsequently raised the limit to 1,500 pounds, as we found in the latter pressure that more volume of free air displacement could be obtained. It was also noted that the greater the rapidity with which the rust was discharged from the piping, the less possibility existed of depositing rust into the fixture stems. With the larger tank shown in Fig. 1, we clear an average of from six to eight stoppages. A fitter and a helper are required to handle these tanks and they are principally used in large buildings. As an economical measure we are using tanks *A* and *B* which weigh from 35 pounds to 45 pounds. These can be effectively operated by one man and will clear from three to five jobs.

As a result of the use of compressed air with the high pressure method, as compared with the low pressure method, the following saving in time is obtained, based on the time of a fitter, helper and vehicle used in both cases and on the completion of 500 jobs of high pressure compressed air and 300 jobs of the low pressure or bell pump method, where it was necessary to cut the piping in about 30 per cent. of the cases:

| Equipment | No. of Jobs | Average Time |
|---|---|---|
| Bell Pump | 300 | 2 hrs.—53 min. |
| Compressed Air | 500 | 1 " —15½ " |
| Average saving in time | | 1 " —37½ " |

Another purpose for which we are using compressed air is to remove corrosion or scale from house heating boilers. See Fig. 6. It was formerly our practice to clean these by means of hand brushes and wire. The time consumed by the air method, which included the replacing of asbestos covering was from eight to ten hours. When high pressure compressed air is used, a hose of sufficient strength is utilized, together with the copper tubing of various lengths and with a very small bore.

Results show that after the removal of the gas burner, the time consumed in blowing out this rust averages from 25 to 45 minutes in accordance with the size of the boiler. The final saving in the operation, which included the remounting and replacing of asbestos, was from eight to ten hours under the former method as compared with two to three hours under the latter method and included delivery and collection of the tank.

As time goes on, we are gradually finding more uses for compressed air. Recently, we were called upon to locate a gas leak which was concealed in the flooring of an eleven story office building. This leak was very difficult to locate, as the odor was from the second to the sixth floor, but the odor was more pronounced on the second floor and this lead us to believe that the leak was at that point. After cutting the concrete and exposing the piping, we ascertained that the leak was not there but was being carried downward by a force of draft from one of the upper floors and on account of the opening on the second floor, we were not in a position to determine the exact flooring.

*Fig. 5—High pressure tank which is connected to the nearest outlet.*

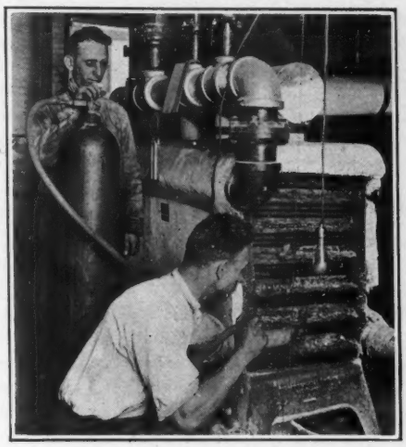


*Fig. 6—Using compressed air to remove corrosion or scale from house heating boilers.*

The tank of high pressure air was attached to a specially constructed connection and used as a reservoir to contain ether. A gauge was connected to the tank and a pressure from 100 lbs. to 125 lbs. was discharged into the piping. The men were stationed at each flooring directly over the point where the piping had been cut on the second floor so that a strong odor of ether was readily detected at an iron column on the fifth floor. The workman in placing his ear close to the flooring could detect a hissing noise. The flooring at this point was cut and we found that at some time alterations had been made to the flooring and some piping removed. The tradesman apparently was short a ½-in. iron plug to use in the end of a tee, so he removed it from the piping and put a wooden plug in its place. The extent of time in locating and repairing this leak was sixteen hours.

Before we undertook this job, and also while working on it, the management called in a representative of several of the largest plumbing establishments in the city and they showed no desire to undertake the work. One firm stated that if the work was undertaken, it would be under the guarantee of not less than two weeks to locate and repair the leak.

In many other instances, compressed air at high pressures has been successfully used. We have used it in blowing out an obstructed drain pipe into the city sewer; also, we used it where the house line was over 1,000 feet in length underground. This house line was trapped and filled with water. By releasing the full charge of the tank into the line we were able to scatter the water so that temporary service could be given. Owing to the location of this trap, which was a con-

siderable distance from the meter house, only a portion of the water could be removed, the force of the air scattering the water along the diameter of the pipe, which again would seek its level and cause trouble. In this particular case we were compelled to make permanent remedies by removing the trap.

On another occasion a consumer in one of the former ammunition plants desired to use an old 6-in. steam line, buried in the ground, for gas. Our company was requested to test the line for tightness, and our investigation developed the fact that the line was waterlogged. Two large tanks of air under 1,500 pounds pressure were connected and released at the same time. As a result, the water was driven from the line and forced out of a manhole opening 400 feet away and thrown to a distance of about ten feet in the air.

We have another case of stoppage in a line under one of the city piers. This line was supplied from the meter by a 2-in. pipe, 1,200 feet long. Two tanks of air were gradually released into the line and when discharged into the open the stoppage was thrown about 30 feet into the air, against the rafters of the pier.

Our company feels that from the excellent results obtained, the use of highly compressed air is indispensable in rendering good service to our customers. It has proved an inexpensive and satisfactory solution of one of our most aggravating problems.

## DEATH VALLEY RANCH HOTTEST IN UNITED STATES

GREENLAND is the suggestive name of a ranch in Death Valley and ten years of records there indicate that it is the hottest region in the United States, and probably on earth. The average of extreme maximum temperature reported to the Department of Agriculture since 1911 has been 125 degrees Fahrenheit. Temperatures of 100 degrees or higher occur almost daily in the summer months. The hottest month on record is July, 1917, when the mean temperature was 107.2.

The temperature of 134 observed on July 10, 1913, is believed to be the highest natural-air temperature ever recorded with a tested thermometer in the shade. Death Valley is from two to eight miles wide and about 100 miles long, lying between high mountain ranges. It is the deepest depression in the United States, some estimates placing its lowest point at 337 feet below sea level. Greenland ranch is 178 feet below sea level.

The combination of temperature and altitude—if you call it altitude—with, in addition, the water for the intercooler above 100 degrees, and not much at that, suggests a few interesting complications in the operation of an air compressor.

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According to Dr. David White of the U. S. Geological Survey a great oil development is predicted for South America. Dr. White also claims that 13,000,000,000 barrels of the estimated 60,000,000,000 barrels of the world's total supply, lies under the surface there, and geologists have evidence of high-grade petroleum deposits.

## NEW AIR TOOL REDUCES LABOR OF "PICKING"

ANOTHER substitution of mechanical methods for slow and costly manual labor has apparently been made in the case of a new air operated tool that does the work of ordinary hand picks. With this new tool it now seems probable that laborious hand picking can be dispensed with on many excavation jobs with a considerable saving over former hand methods.

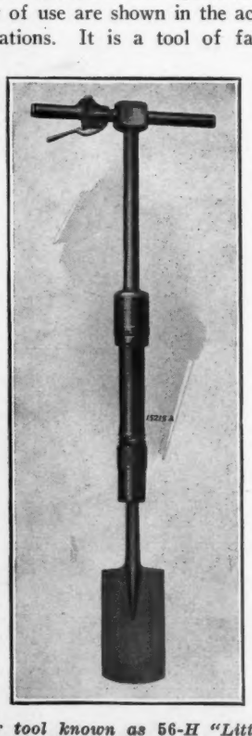
On many digging jobs in stiff clay and hard soil for trenches, shafts, tunnels, etc., the ground is not hard enough to be drilled and shot and yet it is too hard to be removed with the ordinary hand shovel alone. Where a large power driven machine can not be worked the usual procedure is of course to employ a gang of men with hand picks to loosen the ground for hand shoveling.

This new air tool has been developed for use by contractors to eliminate such hand pick work. Its entry into the contracting field affords a marked labor saving over the old methods so long in use.

In ordinary soil by the pick and shovel method one shoveler serves one man with a pick. With one of these pneumatic diggers, one man can ordinarily loosen as much ground as five men with hand picks and the rate will average higher than this in the long run. The man with the air tool maintains a more uniform rate of work with fewer pauses for rest as the work is less fatiguing than swinging a hand pick. One man will loosen enough dirt to keep five shovelers busy all the while, a pronounced saving over the hand pick method.

The danger of accident from careless swinging of the hand pick is also eliminated so that the men are able to work close together in a trench or shaft.

The new compressed air operated tool and its manner of use are shown in the accompanying illustrations. It is a tool of fairly light



*New air tool known as 56-H "Little David" clay digger, (extension handle type), for use in trench digging, open cuts, shaft sinking, etc.*

*"Little David" clay digger, No. 56-H, extension handle type, being used in trench excavation to replace the ordinary hand picks.*

weight (23 lbs. complete) which a man operates while standing in an upright position. It is, briefly, an air hammer with a cross-bar extension handle, being 34 inches in overall length. A digging blade is held in the nozzle end of the hammer by a suitable retaining device. In operation the blows of the hammer drive the blade into the clay or hard ground so that it is sliced or pried loose.

For clay the blades are approximately 6x8 in. of a slight scoop shape, and known as "clay scoops." For earth they are 5x9 in. rectangular with a flat face 5/8 in. thick at the top and 5/16 in. thick at the bottom with the cutting edge beveled from the back, and so are called "flat picks."

The throttle is conveniently located in the grip handle so that the air can be readily shut off as the tool is lifted from one position to another. A buffer inside the retaining nozzle takes the blow if the hammer is operated while the tool is being lifted. An operator, however, soon learns to automatically shut off the air as soon as he starts pulling up on the handle.

This tool is manufactured by the Ingersoll-Rand Company, 11 Broadway, New York, and is known as the No. 56H "Little David" Clay Digger (Extension Handle Type). As the name implies this tool is a development from the pneumatic diggers so extensively used in tunneling through clay, the same type hammer being employed in both tools.

The pneumatic clay digger has become a necessary part of the contractors' equipment in driving through clay in sewer tunnel work and hundreds of these tools have been employed on such operations to replace hand picking. The cost of tunneling has in many instances been reduced as much as 40 per cent. by the use of these machines. It is only natural that, contractors, having witnessed the possibilities of pneumatic digging in tunnel work, should have extended the use of such tools to operations of a similar nature, i. e. trench digging, shaft sinking, etc. Here also when fitted with an extension handle, the pneumatic digger has been found to be equally as successful as a labor saver and as a means of speeding up the work.

# The Manufacture of Naval Stores

## How Turpentine, Rosin and Pine Oils are Extracted from the Stumps and "Down" Wood of the South by the Steam and Solvent Process, and the Part Played by Compressed Air at a New and Modern Plant

By N. S. GREENSFELDER
Hercules Powder Co.

NAVAL STORES is a term used in speaking of rosin, turpentine, pine oil, ship pitch, tar, and similar materials, and the manufacture and distribution of these products constitutes one of the largest industries in the Southern states.

More than 80 per cent. of the world's output of Naval Stores has been obtained in the United States. Practically all of this country's production has been secured from the long leaf yellow pine *pinus palustris* by gashing the trees and catching the resinous sap which flows from the trunk to heal the wounds.

This sap is caught in cups attached to the trees, and collected daily by men making the rounds of the tapped trees on the turpentine farm. Rosin and turpentine are then separated by distillation.

Unfortunately for the future of this great industry, our forests of long leaf yellow pine are almost exhausted. Looking a very few years into the future we can see the day when this country will have no forests from which to produce naval stores. The situation is made more acute by the fact that after being gashed for the production of rosin and turpentine, these trees become very inflammable and the risk of disastrous forest fires is greatly increased. Consequently, many owners of forest land refuse to allow their timber to be worked for turpentine. Our country, therefore, must look to other sources of supply, if it is to retain its preëminent position in the naval stores industry.

Fortunately, another source of supply is at hand. About ten per cent. of this country's output of rosin and turpentine has been obtained from the stumps left in the ground after the yellow pine timber has been cut. It is from this source that the Hercules Powder Company's three naval stores plants obtain their raw material. The stump that is left in the ground is richer in turpentine than the trunk of the tree, and can be effectively blown out by the use of dynamite. Wood camps carry on this work, and ship to the plants "stump wood," blown from the ground and "top wood" or "down wood," which is the dead timber left on the ground after the lumber operators have worked over the land.

The stump wood is richer in extractable products and is correspondingly more valuable. Top wood is the upper part of the dead tree. It is a curious fact that the section of the tree from about ten feet above the ground to the first limbs is generally very poor and is culled, while above the first branches the rosin and oils are found in both the branches and the body of the tree in considerable amounts. It seems to be generally true that the twisted grain wood is richer than the straight grain. This is explained, in a rather unscientific way it is true, on the ground that the oils and rosins passing through the interior of the tree are held back by the bends and and gradually accumulate there. At any rate, whenever there are any twists and knots one finds extractable products in large amounts.

The distribution in the roots is also interesting. The *Pinus palustris* has two types of roots, lateral and tap. The lateral roots are close to the surface of the ground and are very rich in rosin, turpentine and pine oil; the tap root, each tree usually having but one, goes straight down into the ground. It is soft and spongy and contains practically no valuable products—in fact it is almost worthless even as fuel. It is the general belief that the tree obtains most of its moisture from this source.

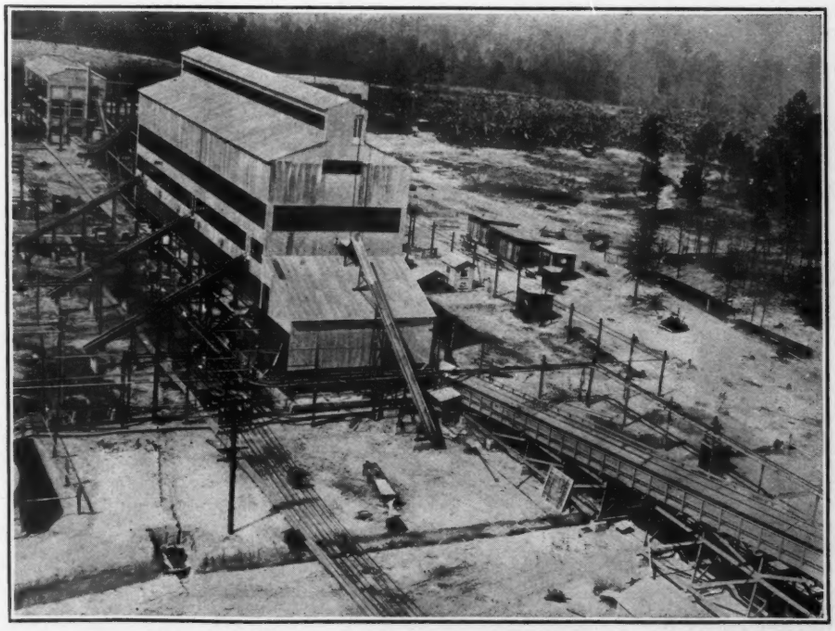
In wood operations the top wood is simply cut into four foot lengths and split if too large in diameter for milling. Stumps are generally blown out with dynamite. The pieces are hauled by wagons to a tram line or railroad and loaded into box or rack cars on which the wood is transported directly to the plant.

In order for the wood to be suitable for use it should age for several years; top wood requiring at least five years and stump wood two or three years longer. "Green" or insufficiently aged wood has been tried from time to time, but the difficulty experienced in milling is so great that its use is impractical. Furthermore, the yields are not so great as with the well-seasoned material.

Good land yields eight to fifteen tons of wood per acre, depending on the section of the country. Therefore a plant having 500 tons per day capacity would receive daily the wood from about 50 acres of land. From these figures one can obtain some idea as to the magnitude of the wood operations and of the benefits Southern agriculture will derive from this wholesale removal of stumps.

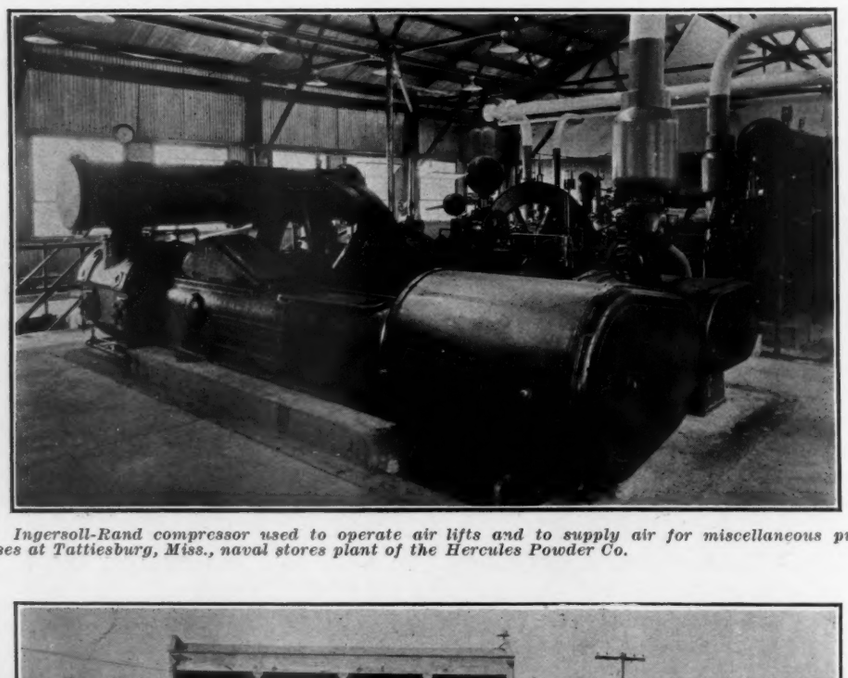
### Various Steps in Process

This stump and top wood arrives at the plant in railroad rack cars. The operation of the naval stores plants is briefly as follows: The wood is first ground into small pieces, or chips. It is then loaded into steel tanks (extractors), where the crude turpentine is driven off by the use of live steam. Next, it is covered with hot gasoline and boiled for a considerable length of time. This dissolves the rosin and the gasoline-rosin solution is then drawn off. Steam is next introduced into the extractors to recover the gasoline which has been left in the wood. The crude turpentine is refined by distillation; the gasoline and rosin are separated, and the latter purified and barreled.

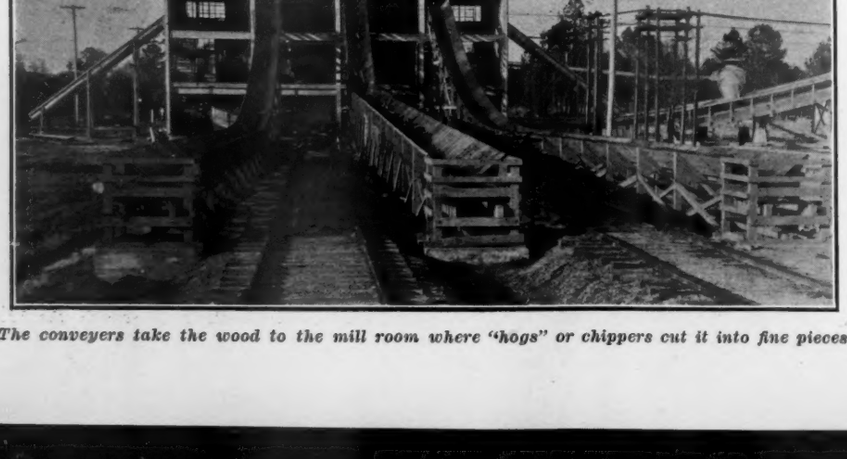


*Extractor house equipped with modern apparatus for distilling the fresh chips for turpentine and solvent for the extraction of rosin. The wood used as raw material is seen in the background.*

*Power house at the plant at Hattiesburg, Miss. "Spent" wood from which the valuable products have been extracted is burned in the boilers. The air compressors used are driven by steam.*



*Ingersoll-Rand compressor used to operate air lifts and to supply air for miscellaneous purposes at Tattiesburg, Miss., naval stores plant of the Hercules Powder Co.*



*The conveyers take the wood to the mill room where "hogs" or chippers cut it into fine pieces.*

The following detailed description fits the Gulfport and Brunswick plants of the Hercules Powder Company:

The wood from the rack cars is loaded on a chain conveyer, which carries it to the upper floor of the mill room. From this floor, it is fed into a machine called a "hog," which cuts it into comparatively small pieces (hog chips). These are then fed into a hammer mill, or shredder, which grinds them to the desired size, and the shredded chips are delivered to a belt conveyer which carries them to the top of the next building and deposits them into a storage bin or directly into the extractors.

The extractor house is equipped with a row of tall steel tanks, in which the chips are treated, condensers for cooling the vapors, separator tanks, washers, pumps, belt conveyers, and other machinery. An extractor is a long, cylindrical, steel tank set up on end. It has a round door in the top through which the fresh chips are loaded and a large side door near the bottom through which the spent chips are emptied. The chips rest on a grid, or screen, supported a few inches from the bottom. Live steam can be introduced into the space below the screen and will force itself through the chips to an outlet on top which leads to the condenser.

A copper coil is also in this space below, so that when boiling for rosin, the contents of the extractor may be heated without the introduction of live steam. The operation in this house is so carried on that one extractor is emptied approximately each hour, although the chips are in an extractor sixteen hours or more. The operator keeps a watchful eye on a whole row of extractors. He opens a valve here, closes a valve there, regulates the temperature of his condensers, runs gasoline into an extractor or draws solution out of it. His multifarious duties suggest the responsibilities and the remote control that characterizes the work of a signal tower man.

## Distillation of Turpentine

When the extractor has been filled with fresh chips, the upper and lower doors are closed and sealed tightly. Live steam is then introduced into the chips, and crude turpentine is distilled off. A mixture of water and "crude turps" comes through the condenser and flows to a separator tank, where the turpentine rises to the top and the water sinks to the bottom.

The operation of this separator tank is continuous and the crude turpentine is constantly drawn off the top and water off the bottom. After from three to five hours steaming, little or no turpentine is left in the chips, and they are then worked for rosin. Hot gasoline solution is introduced into the extractors so as to completely cover the chips. Steam is turned on, and the gasoline solution is boiled. After it has boiled for a sufficient length of time to extract most of the rosin from the chips, the solution is drawn from the extractor into the wash tank. This washer is similar to one of the extractors. As the solution enters it near the bottom, a spray of cold water is directed on it from above. The spray cools the solution and throws out

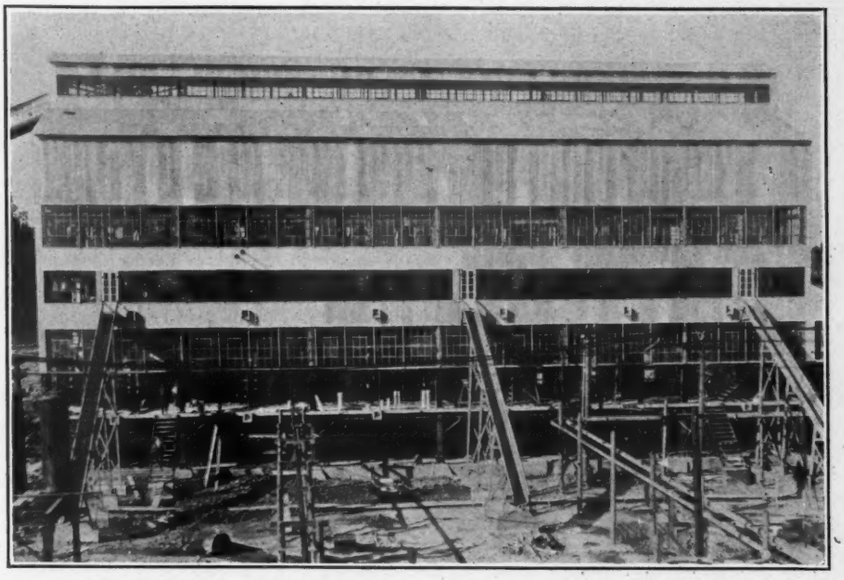
a certain amount of black resinous material popularly called "nigger," which is detrimental to the color of the rosin.

The chips in the extractor are given further washings with hot gasoline solution, which tends to extract more rosin and to wash out the concentrated rosin solution. These subsequent washings are then passed on to extractors containing fresher chips and are finally taken to the washer in their turn, the last treatment being with fresh gasoline, which is then drawn from the extractor. Live steam is introduced and the gasoline left in the wood is distilled off. This steaming for solvent, as it is called, takes about five hours. It is very important, both for the economy and the safety of the plant operation that practically all of the gasoline be driven from the chips. A mixture of gasoline and water is now coming from the condenser, and this is led to a solvent separator similar to the turpentine separator tank mentioned above. At the solvent separator, gasoline collects at the top and water at the bottom, and these two liquids are constantly being drawn off.

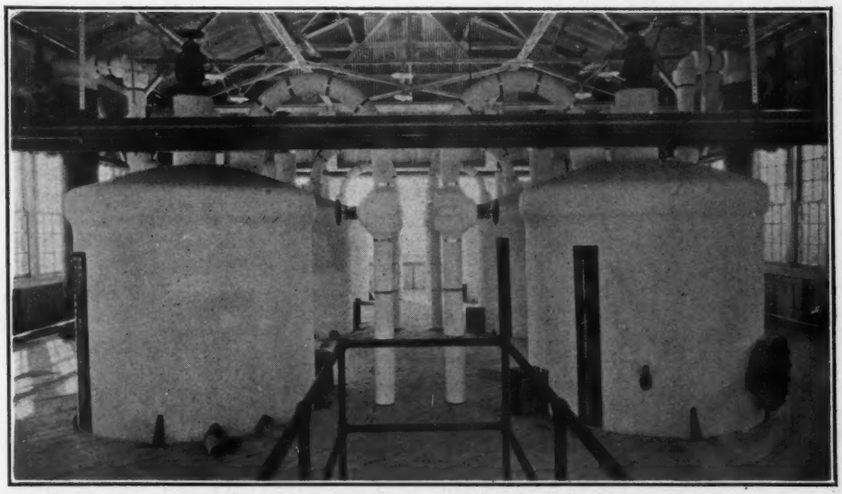
When all of the gasoline has been driven out of the chips, the lower door of the extractor is opened and the spent chips are pulled out and dumped on a conveyer belt, which takes them out of the building into the top of a fuel bin. This bin is of fire resisting construction. From it the chips are carried by a chain conveyer into the boiler room to be burned. Thus the waste from the plants is used to supply steam and power for the operation.

From the extractor house, the so-called "crude turps" is pumped to the refinery, where it is run into a tank, or pot, fitted with a steam coil. Steam is turned on and the contents driven off through a condenser. The first product obtained is pure wood turpentine, called in the plant "P. W. Turps." The remainder is a mixture of turpentine and pine oil. This mixture is re-distilled and more turpentine obtained. The gasoline solution, containing the rosin, is pumped to the refinery. Here the gasoline is driven off and returned to the storage tanks, from which it is again used in the extractor house.

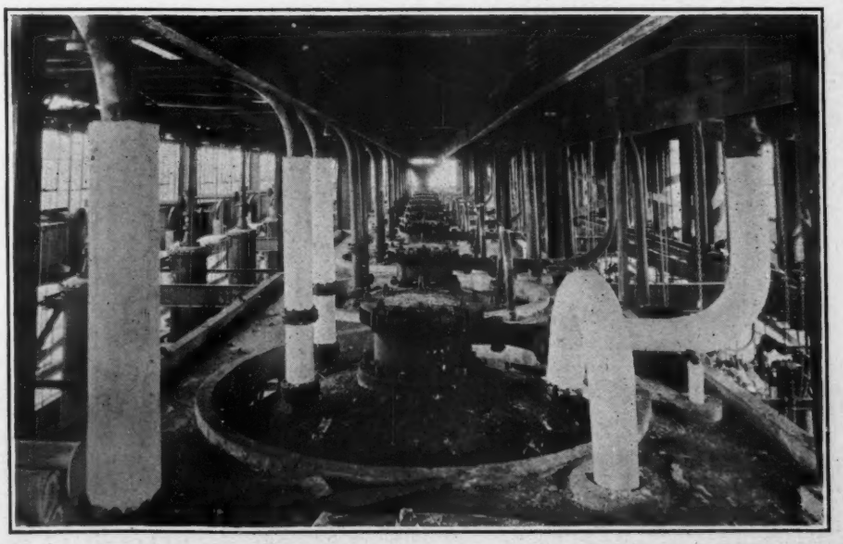
What remains is a crude rosin—a mixture of rosin and pine oils. By further treatment, these are separated and the finished rosin barreled. The rosin solution is run into a pot, steam at about 50 pounds pressure is turned on, and a vacuum applied to the system. A small amount of live steam is introduced into the pot to assist in driving off the gasoline. The vapors pass out through a condenser and return to the system in the same manner as the gasoline recovered when "steaming for solvent." The crude rosin left in the still is transferred to another pot, where it is given a treatment similar to that which the rosin solution received. This time, however, the steam pressure, and consequently the temperature, is higher, and as a result the pine oils are distilled off, leaving the finished rosin. This, while still hot and liquid, is run by gravity into loading tanks, equipped with steam and water coils, so that the temperature of the rosin may be accurately regulated. From here the rosin is loaded directly into bar-



*Extractor building of the fire proof construction. This extractor house is equipped with modern apparatus for distilling fresh chips for turpentine and solvent and for the extraction of rosin.*



*Rosin finishing stills. After leaving the extractor house the crude solution containing rosin and pine oil is pumped to the refinery, where the last traces of pine and solvent are removed from the rosin.*



*Interior of extractor house where the shredded chips are fed into the extractors where the turpentine is distilled off by superheated steam, while the rosin is dissolved by heated gasoline.*

rels and weighed. When it has cooled and solidified, it is rolled to its position in the yard and loaded directly into cars.

### Use of Compressed Air at a Modern Plant

At the Hattiesburg, Miss., plant of the Hercules Powder Company, which has recently been completed, all water used is obtained from wells, seven in all. Air lifts are used for pumping water from the individual wells into a reservoir.

Each well is equipped with an Ingersoll-Rand foot-piece and deflector tank. The plant requirements are supplied by two air compressors, one of which is the Type XPV, shown in the accompanying illustration, having a capacity of approximately 1200 cu. ft. of free air per minute with a discharge pressure of 50 to 150 lbs. per square inch. Either compressor is capable of handling the plant requirements of 2500 G.P.M. so that there is always reserve capacity available.

Compressed air is also used at the machine shop and shredder house for cleaning machinery, and for the same purpose at all of the buildings where motors are installed.

## COMPRESSED AIR OPERATES STABILIZER FOR HELICOPTER

COMPRESSED air is used to good advantage in an improved helicopter type of flying machine developed by Leinweber Brothers of Chicago. They have perfected a stabilizer that operates automatically by compressed air. The least tilt of the machine out of balance swings a pendulum that sets in motion a compressed air motor. This in turn opens up valves and allows the air to enter the motor. This rights the machine instantly.

This new machine may well be said to be a direct descendant of the humming bird, for it was that busy little nectar-gatherer that first suggested to the father of the Leinweber Brothers many years ago the possibilities of developing a machine that would hover in the air, or move backward or forward at will. Many a time did he watch these birds intently, trying to wrest from them their secrets of flight. He saw that three things were essential,—first, a motor of extraordinary power; second, a different type of propeller from those then in use, one that would catch the air and hold it as in a cup; third, propellers that could be tilted to any angle desired.

After the father's death, the sons continued the experimental work. The result has been a new type of propeller; a motor that has immense horsepower for its weight, and a system of tilting the propellers to any angle by means of compressed air.

The Leinweber helicopter flying machine weighs 1,500 pounds, is 25 feet high, 20 feet wide, and has two 100-horsepower motors.

That the great world powers are wide-awake to the possibilities of a type of aircraft that can hover over a determined spot and can rise or descend vertically is shown by the fact that the British Air Ministry has proposed an offer of 50,000 pounds sterling for a practical helicopter.

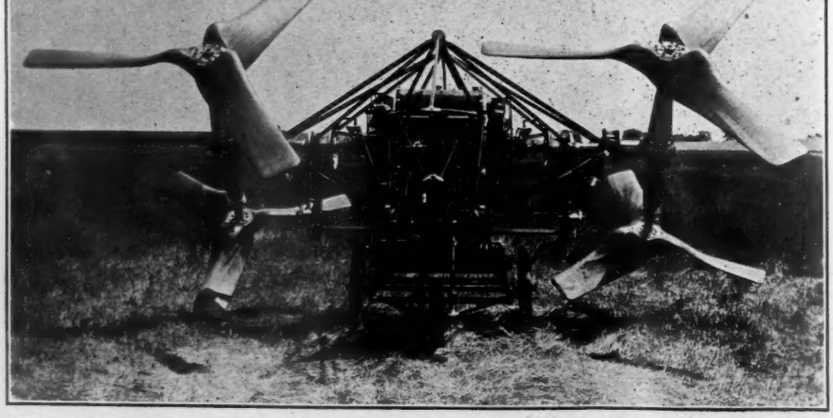
It is reported that a large machine of the Leinweber type with twelve large motors and twelve propellers and several automatic balances is to be constructed.

## AERO PUMP DISPENSES FILTERED GASOLINE

The dispensing of filtered gasoline by a compressed air controlled self-measuring pump is the latest innovation of service to be introduced at the Helena Gas Service station at Helena, Mont., where a new Aero pump of latest approved type has been installed to measure out the Montana Arro gas, a product of the Lewistown refinery.

One of the outstanding features of the Aero pump, from the motor car owner's standpoint, is that it effectively filters the fuel to remove all water, dirt and sediment, insuring cleanliness and purity. The measuring device is automatic, being operated by compressed air and controlled by a meter-counter, which may be set for quantities of one, two, three or five gallons.

The general appearance of the pump differs little from universal standards now in use, but the application of power replaces the slow and laborious operation of the older types, and gives the added protection to the customer of filtration and automatic meter measuring.



*Front view of helicopter with a compressed air stabilizer.*

## THE AIR GUNNER

*By MAURICE MORRIS*

[In "N. Y. Tribune"]

The howitzer and the gunman's gat,
The derringer ancient, the automat,
The modern rifle, the Lewis machine,
The sixteen incher, the big marine,
Possess no terrors that can compare
With the riveteer and his gun of air.

Two hundred feet on high he sits
In a steel spun web and rings up hits
And swings his legs in a keerless style
As he catches the rivets double file.
White hot and a-sizzle they spit and spat,
But he slips 'em home and he springs his gat.

And of all the infernal sounds unbanned
Since Adam weakened and Eve was canned!
Stentor was only a bleating lamb,
The cave of the winds was a soundless calm,
Yea, old Bill Klem and his deepest clangor
Compared to this was mere genteel languor!

And the worst of it is he's an early bird
Who flits to his perch ere the dawn has stirred
And Morpheus kills with his first fierce cheep
As you turn in bed for your beauty sleep.
If he belongs to the union, then
They have jumped their hours from eight to ten.

I'm strong for progress. I look with glee
As the city spreads like a restless sea,
But deep will my joy be, just the same,
When they've riveted up the last steel frame—
Or if that's too much to hope for yet,
Then put 'em up soft and let 'em set!

## SOUNDING BY SOUND

The measuring of ocean depths is now accomplished by means of a novel and ingenious device which literally employs sound as its responsible agent. The instrument is called the Weight, and the theory of its action is easily understood. When any weight is dropped free into deep water the force of gravity and the displacement resistance of the water quickly balance each other and then the descent of the weight becomes uniform and at a rate which has been reliably determined by experiment.

The Weight used for sounding consists of a metal ball to which a small bomb is attached. It is dropped into the water and when the bottom is touched the bomb explodes. The sound of the explosion is received on the vessel by a sound receiver and the time from the instant the ball touches the water to the moment when the sound is recorded is taken by a stop-watch and from this the depth may be calculated with close approximation.

Alexander Crawford Chenoweth, consulting engineer, died recently of heart disease at the Fourth Avenue Hotel, aged seventy-three years. Mr. Chenoweth was at one time resident engineer in charge of the Croton Aqueduct and much of his work was done in connection with municipal enterprises. The foundation of the Statue of Liberty was prepared by him. He served as resident engineer of the aqueduct from 1889 to 1895. He was born at Baltimore and was educated at Dickinson College and Rensselaer Polytechnic Institute. He is survived by his wife, who was the daughter of former Mayor Fernando Wood, of New York, and one son, Alexander, Jr.

## CALIFORNIA RAILROADS CONSERVING FUEL OIL

PYRAMIDING costs and the gradually widening breach between production and consumption of crude oil in California is bringing to railway operating officials and executives more keenly each day a problem that is assuming serious proportions, owing to its important bearing on the successful conducting of transportation in oil burning territory.

One of the most active companies in the development line in California at present is the Sante Fe Railroad, which is finding it difficult to get enough oil to operate its properties.

In a single decade the consumption of fuel oil by railroads has more than doubled. The consumption of the Southern Pacific Railroad amounts to about 60,000,000 gallons per month, or about 16 per cent. of all oil produced in California. During the year 1920 the company's consumption averaged 51,000,000 gallons per month, and in 1914, 41,000,000 gallons.

In years past when crude oil was produced in about equal quantities as now and sold in the open market at a price even less than one cent per gallon, scant attention was given to the thought that in the future, conservation of this commodity would have to be practiced. Recently, however, there has been occasion for conservation and fuel economy is now a very live question with all railroads operating oil burning locomotives.

The use of oil as fuel has greatly increased the efficiency of locomotives, and has eliminated much labor particularly on the part of the fireman. It is handled and stored easily. The accompanying illustrations show the ease with which fuel oil for locomotives may be handled and stored. In Fig. 1 is shown the 55,000 barrel oil storage plant maintained by the Southern Pacific Railroad at San Francisco for supplying passenger locomotives operating out of San Francisco on the coast division. Only two men are required to operate this oil storage plant.

The 55,000 barrel tank receives its supply from the oil storage plant operated by the Associated Oil Company on San Francisco Bay a few blocks from the Southern Pacific, the oil being delivered to the Associated Oil Plant by tank steamers and barges.

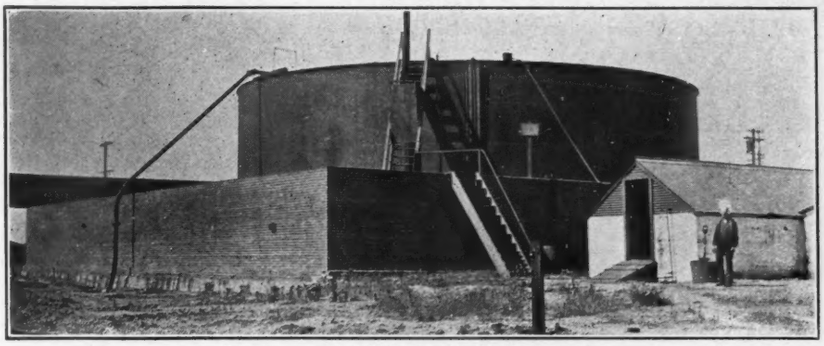


*Fig. 1.—The 55,000 barrel oil storage plan*

A brick wall entirely surrounds the 55,000 barrel oil tank, which not only saves the oil in case of a leak but also protects the surrounding buildings in case of a fire. This large tank is connected to two steel tanks by an eight-inch pipe. These two tanks are buried under the ground, and receive the oil from the large tank by gravity.

By means of compressed air the oil is delivered through pipes to the oil columns, which in turn deliver the oil into the fuel oil tank of the locomotives. The oil in one of the two buried tanks is always under air pressure, thus the locomotives never are required to wait for a supply of oil. While one of the buried tanks is delivering oil to the locomotives the other tank is being filled. When the oil in one of the tanks reaches a certain level, a float shuts the supply of oil off, and at the same time opens an air valve which permits compressed air to enter the top of the tank, of sufficient pressure to force the oil out of the bottom of the tank to the oil loading columns. At the same time another valve is opened permitting oil from the 55,000 barrel tank to flow into the empty buried tank, and at the same time shuts off the supply of compressed air from the empty tank, and releases what pressure is in the tank so that the oil may flow in. This operation continues from day to day, without any attention from the attendant.

Fig. 2 shows the loading column and the method of supplying oil to a locomotive. The oil column is seven inches in diameter with a swivel joint at the top, to which is attached a pipe with a counter balance weight at one end and a globe valve at the other. A telescoping pipe extends downward from the valve, which is used to deliver the oil into the oil tank on the locomotive tender.

The flow of oil into the tank is controlled by the globe valve. For the purpose of catching the oil that may drip from the end of the telescoping pipe, there is a drip pan attached to a pipe, which drains the oil into a sump at the base of the oil loading column. This drip pan and pipe is placed at the base of the oil loading column. The pipe to which the drip pan is attached is arranged to slide within another pipe, which permits the pan to be moved from under the telescoping pipe, while oil is being delivered. As soon as the telescoping pipe is raised, the pan is moved over until it is directly under same.

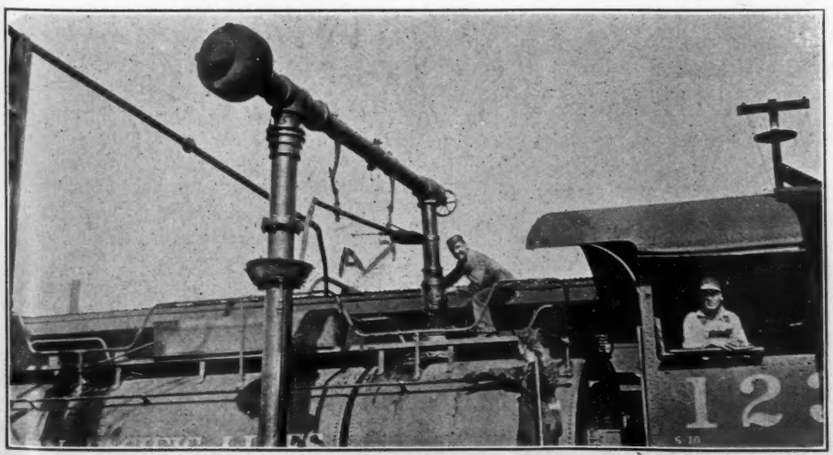


*Fig. 2.—Arrangement by which compressed air forces oil through column to locomotive.*

## OIL SHALE INVESTIGATIONS

Preliminary experiments have been made at the Salt Lake City station of the Bureau of Mines on topping shale oil samples to learn the effect of barometric pressure on the amount of light distillate produced. The experiments emphasized the necessity of "cutting" the distillation at different temperatures, depending on the barometric pressure in order that unsaturation determinations will always be comparable. Investigations are being made at this station to determine what principles are responsible for the fact that the oil shale assay retort yields better oils than other retorts when treating any shale. Results show that the best oil is produced at slow rates of heating, and that repeated condensation and redistillation is not responsible for improvement in the oils when retorting. A new study is under way at the Salt Lake City station in which the shales will be heated to different temperatures within their range of thermal decomposition. The oils, gas and spent shale simultaneously produced will be examined. A method is being worked out whereby various types of retorts can be compared when the rate of distillation is determined.

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A demonstration of oxy-acetylene welding and cutting of ordinary structural steel featured a luncheon of the Engineers' Club at Seattle recently. B. D. Kinsey of the Seattle plant of the Linde Air Products Company conducted the demonstration. He gave a brief talk on the manufacture of oxygen, as used in commercial work in oxy-acetylene welding and cutting.

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*EDITORIALS*

## AIR PRESSURE TO CURE CAISSON DISEASE

IN THIS issue we describe a method for successfully treating what is known in medical circles as caisson disease or as it is more commonly called the "bends" by placing the victim in a tank filled with compressed air at a pressure sufficient to break up the bubbles of nitrogen gas absorbed into the blood stream. The formation of gas bubbles of nitrogen in the body fluids and tissues is the accepted theory at present of the cause of caisson disease.

Caisson disease, compressed air illness, or, more properly speaking, air embolism, is a condition caused by a too rapid decompression after exposure to higher pressures for a period of time. The symptoms of compressed air illness are vertigo, difficult breathing, localized pains, affections of the central nervous system, and unconsciousness or collapse.

The importance of having correct information on this subject, in order to protect the health of the workers and prevent injury or loss of life in deep mining operations, subaqueous tunneling and bridge building, has been recognized by the U. S. Bureau of Mines and accordingly a comprehensive report is contained in a paper prepared by DR. EDWARD LEVY, consulting physiologist of the bureau and also consulting physician, New York State Bridge and Tunnel Commission, giving the writer's valuable experience in the treatment of this disease.

In an employment so hazardous as that of a "sand hog" some attention should be paid to the class of men best fitted for it. Actual experience has led to the conclusion that in the selection of men the essentials are normal lungs, normal kidneys, and a good heart; in the older men the blood pressure must not be high. Furthermore, in the selection of workmen for compressed air operations, the report says it has not yet been definitely ascertained that advanced age is quite the important factor that many writers have insisted; neither is it considered that fleshy men are unduly susceptible to compressed air illness.

Compressed air work has assumed a place of enormous economic importance in modern engineering. The construction of underwater tunnels or "tubes," the principal means of intercommunication between such large business centers as Manhattan Island and Brooklyn, would be impossible without it. The prosecution of these various activities requires the employment of numbers of men who must work under varying degrees of air pressure. The effect of compressed air upon the life, health, and efficiency of workers becomes, therefore, of increasing importance in the study of occupational diseases and the medical problems of industries.

No thorough research has yet been done in this field in the United States. Knowledge of the cause, character, and treatment of compressed air illness is still limited to a very few physicians, and it presents a wide field of ever increasing usefulness as well as an attractive one for future achievement to the medical profession.

## MID-SUMMER REINFORCEMENT

AND NOW the Summer holiday season is wide open. The custom of providing an annual vacation for every active worker, ranging from two weeks as a minimum to a more extended period where circumstances permit, is one against which it would be difficult to urge any valid objection. If there could be a constitutional amendment—since such amendments are in fashion—requiring every man, every woman and every child to have a proper holiday every year it doubtless would be as well respected and observed as are some other of our wise enactments.

But while the vacation idea is so welcome and the anticipation of a spell of rest and recreation is so bracing, the realization and the recollection of the same are too often disappointing. The fact is that our allotted periods of play—if we thoughtlessly call it that—require as wise and as careful planning as does our most serious work, and this they seldom get. The instinctive and habitual longing for the let-up is sufficient guarantee that the time will not be a waste and that nothing really is sacrificed, but quite the reverse. These are truly times of reinforcement, adding strength and vigor and increasing and extending ultimate productivity.

With those who are chained to routine the dominating idea of the vacation is to have a change, a change as complete as possible both of location and of occupation, the former the more insistent. Where are you going for your vacation? is the most familiar friendly question, what you will do following by implication. The rest of utter inaction is seldom thought of. The hands which are busiest for the fifty weeks are not to be folded for the fortnight. And why not? With the movies all the fashion and the movie habit fixed upon us all why can we not secure a comfortable reserved seat and watch the continuous unrolling of Nature's unending movie reel? Bright daylight, the broad landscape and the free fresh air should make us forget for the time the dark and crowded hall with which we are too familiar.

It is not for us to suggest what is to be seen, even were it possible, there being a constant change of picture and of setting with no repetitions. It might be specially in our line, perhaps, to speak of the ever present opportunities for studying, or at least of watching, the constant succession of atmospheric phenomena or of those in which the atmosphere is the principal actor, and this whether overlooking the water or the land, and by night as well as by day. A seat with a good view of the ocean, or of one of the great lakes or a broad, strong-flowing river would each give us a different set of remembrances.

We speak of the restless sea and the ever-tossing waves, forgetting for the most part that every wave which furrows the normally smooth and level surface is entirely begotten of the wind. No wind yesterday or to-day, no wave to-day or to-morrow. That the waves never cease is only because the wind is always blowing. It would seem that the wind is more active and unresting than the sea itself, and always it is doing several things at once. It gets dusty and dirty and thirsty as it sweeps over the land and is washed clean again as it sweeps over the deep, ready when so cleaned to perfectly distil the salt water into the freshest and purest and carry it off to broadcast over the land, the ocean meanwhile absorbing its needed portion of air and sorting out and appropriating and distributing the minute but unconvertible solids the air has brought for its fishes and its plants. When the white-caps are feathering the crest of every wave the interchange of burden between the water and the air is most active and the effects of it are finally appropriated thousands of miles away. The interaction is unceasing and the story of it would be a continuous serial.

Other phases of the atmospheric function may be studied in our periods of summer "leisure" with no water in sight. We might find a comfortable seat upon a rock far up the hillside overlooking broad expanses of farm land and watch the waves sweep along the tops of the grain as stirred by the wind, and watch also the chasing shadows of the flying clouds with their alternate transformations of coloring. Then if we turn our eyes upward we can watch the making or the unmaking of the clouds which, one or the other,

is always going on. It may be trying to the eyes, and more so to the patience, but is well worth while. On a bright, sunny day the light, fleecy, scattery clouds, with the clear blue for a general background, are changing shape and arrangement continually while you watch, and they have especially the trick of disappearing before your eyes. They are detached and separated, portion after portion, then they grow thinner and thinner and then they are gone, converted from visible water globules into true invisible steam. The sun has so raised the temperature that they have actually boiled away before your eyes. You may have many a chance to watch all this as you sit holding a fishpole, and then you will not be able to say you have caught nothing.

The reverse of this operation, the forming—not the bringing—of heavy clouds to rapidly fill a clear sky, shutting off the sunshine and hanging all visible space with clouds of sombre shade is more difficult to watch with any clear understanding of what and of how it is done. We never really know the beginning of a thunderstorm. The first thing we know is that the performance has begun. Only a slight change of temperature or of barometric pressure, or of both occurs and the invisible steam in the air is condensed and the clouds are formed and the water pours down. The rapid shutting off of the sunlight, the sudden darkness, the rushing wind, the sharp lightning, the heavy thunder and the torrent of rain form an impressive combination not to be forgotten in the recollections of our outing.

If we do not express a wish that every reader may be caught by one of these typical summer outbursts we at least hope that one and all will find restful and recuperative change to the limit of their expectations.

R.

## THE STRUGGLE OF FAMOUS INVENTORS FOR RECOGNITION

THE history of a number of great inventions was cited in a brief recently prepared by the American Patent Law Association in opposition to the new Stanley patent bill which latter contains the provision that inventions not commercialized within five years might be subject to exploitation by any one upon the payment of a royalty fixed by the courts. According to the records it is shown that many famous inventions could have been taken away from the inventors or owners if such a law as the one now proposed in the Stanley bill had been on the books at the time the discoveries of these contrivances or apparatus were announced.

According to THOMAS A. EDISON the supposed deliberate "suppression" of discoveries is nothing but a myth. He is quoted in opposition to the bill as follows:

"I have heard and read numerous statements that many corporations buy valuable inventions to suppress them, but no one cites specific cases. I myself do not know of a single case.

Mr. WILLIAM W. DODGE in commenting upon the history of other well known inventions said:

"I asked Mr. INGERSOLL of the Ingersoll Watch Company how long it took after his first patent was granted to get a watch on the market, and he said from five to six years. I asked what it cost to do it, and he said about $51,000 before they were able to sell their first watch.

"The little Blickensderfer typewriter, with which the public is familiar, involved an outlay of over $400,000 before the machine was ready for the market and consumed years of the term of the first patent before it was placed on the market."

The development period of an invention is usually a long one. Not alone is time required to mechanically perfect the original design but comparatively large sums of money are needed which requires more time to obtain.

It is indeed not difficult but impossible to arbitrarily set a definite interval of time to elapse before placing a new invention within reach of the consuming public as this depends upon so many variables that are beyond the power of any man or organization to control.

## FURTHER RECOVERY OF GASOLINE FROM PETROLEUM

WITH GASOLINE going up a cent more a gallon, the owners of automotive vehicles are reasonably perturbed. With the nation's automobiles, motor trucks, tractors, and motor boats multiplying rapidly, a very considerable percentage of the populace is affected by every change in the price of the indispensable liquid fuel. Not only that, but a vast industry and many activities would be hurt if there were not sufficient quantities of gasoline at a tolerable cost on the market.

The refineries of the United States utilized, during 1920, 433,915,029 barrels of crude oil, including 61,136,210 barrels of Mexican petroleum. This raw material yielded 4,882,546,599 gallons of gasoline—representing an average daily production of 13,340,291 gallons. Besides the gasoline obtained from crude oil by fractional distillation and from heavy oils by "cracking," the foregoing total covers also 3,152,924 barrels of natural-gas gasoline blended with gasoline from other sources. While the figures for 1921 are not yet at hand, it is authoritatively stated that the gasoline production and consumption for the year gone were still higher.

How is the problem of more gasoline from domestic resources to be solved? Can refinery practices or processes be generally bettered so that greater measures of gasoline can be reclaimed from the crude oils undergoing treatment in our plants? Government experts have recently pointed to a promising line of relief.

The U. S. Bureau of Mines advances the suggestion that by the more complete condensation of still vapors at the petroleum refineries 120,000,000 gallons of precious liquid fuel may be added annually to the national output. As the result of a detailed investigation, a technicist of the Bureau estimates that fully 50,000,000 gallons of gasoline were, in fact, recovered from still vapors at our refineries in 1921. It seems that the magnitude of the loss from non-condensation of still vapors has been realized only by a few of the refiners, judging by the number of plants equipped with reclaiming systems, but these alert men are well satisfied with the returns they are getting from their recovery installations. Others can do likewise to their profit and to the public benefit.

The compression and absorbtion processes are used for extracting gasoline. Either of these systems would probably meet the needs of the refiners who have not yet outfitted their plants with apparatus of this sort.

## THE PANAMA CANAL AND GREAT LAKES-ST. LAWRENCE SEAWAY

A STATEMENT by the president of the COMPRESSED AIR MAGAZINE, after his return from a recent trip to the tropics, where ten days were spent on the Isthmus of Panama among engineers and others familiar with the operation of the canal, contains an interesting sidelight on the now famous Great Lakes-St. Lawrence controversy.

The remarks referred to were inspired by viewing the progress of the 12,000-ton ship through the locks of the Panama Canal. The speaker summed up his observation as follows:

"The situation confirms in every respect the position taken in the St. Lawrence Seaway—that the modern lock canal does not seriously interfere with navigation. Our ship went through the entire flight of six locks from the Atlantic to the Pacific side in six hours. The most enthusiastic advocates of the lock system at Panama did not expect passage short of ten or twelve hours.

"The whole thing is an object lesson, a practical proof of the fact that good engineering in the building of locks and canals overcomes the obstacles that are in the minds of shipping men and others when considering a lock system.

"I recall distinctly a meeting of the New York Chamber of Commerce when the United States had just taken over the Panama Canal. Mr. GUSTAV H. SCHWAB, the president of the North German Lloyd Steamship Company, told the chamber that if the canal were built on the lock system it would result in serious damage to ships, and that as president of his company he would not send a single ship of the North German Lloyd line through the locks. But the engineers inform me that in eight years' use not a dollar of damage has been incurred."

It is just so with the St. Lawrence. It is likely that a similar result will obtain, and if this Great Lakes-St. Lawrence project were in operation the folks who now presume imaginary dangers and difficulties would see their doubts vanish with the accomplishment of the reality.

## TO MAKE MOTORISTS HELP COPPER MARKET

In Arizona it is proposed to amend the motor travel law so as to help the copper market, according to *Engineering and Mining Journal-Press*. License plates are to be of copper, of somewhat smaller size than ordinarily used, and are to be accepted at metal value when turned in at the end of the year. It is planned to use Arizona electrolytic copper.

THE UNA-FLOW STEAM ENGINE, by J. Stumpf. Contains a description of the scientific investigations and development of the una-flow principle. 319 pp.; second edition; illustrated. Syracuse, N. Y.; Stumpf Una-flow Engine Co., Inc.

THE SECOND edition of this valuable book represents what amounts to nothing less than a complete revision of the first one. The first edition we are informed in the preface contained a good many opinions in addition to facts and was primarily intended rather for the purpose of defending the una-flow engine against antiquated theories and attacks. In the meantime the una-flow principle has been widely tried out and scientifically investigated. It has become, it is stated, an accomplished fact and is in common use. This book contains, therefore, scientific proof from an objective point of view. In the opening chapters the different losses of the steam engine are investigated and causes and effects are defined as well as the relation between them. A number of chapters are also devoted to a description of several types in widely different fields and varying conditions.

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PRINCIPLES OF MECHANICAL REFRIGERATION, by H. J. MacIntire, S. B., M. M. E., Associate Professor of Refrigeration, University of Illinois; honorary member, National Assoc. of Practical Refrigerating Engineers. Formerly advisory engineer-refrigeration, in construction division of the War Dept. 252 pp., illus., first edition. McGraw-Hill Book Company, Inc. New York, 370 7th Ave.; London, 6 and 8 Bouverie St., E. C. 4.

THIS VOLUME is a compilation of a series of twenty articles published in *Power* during 1920 which were written, we are told in the preface, as a "study course" the attempt being made to present the subject in as clear a manner as possible, each article being complete in itself while the series covered the entire field of refrigeration in an elementary manner. Owing to the popularity of the series among refrigerating engineers, it was decided to publish them in book form. However, in the compilation of the book, the articles have been more advantageously re-arranged and amplified.

The volume has been written in a simple manner with little use of mathematics and to make clear by analogies to steam machinery and steam cycles the action of refrigeration. It is therefore a book for practical steam and refrigerating engineers and the author expresses a hope that others besides practical engineers will find a book of this sort of interest.

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STANDARDIZATION BULLETIN OF THE AMERICAN MINING CONGRESS. Contains proceedings of the Second National Standardization Conference held in connection with the 24th Annual Convention. Chicago, Ill. 271 pp., illustrated. Washington, D. C.: American Mining Congress.

AN ACCOUNT of the proceedings of the joint sessions containing the recommendations of the general committees. This volume embraces national and international standardization along with the co-operation of government and industry. Two main classifications of the subject are made namely, according to metal mining and coal mining. An index of speakers and addresses is also included.

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Henry Vogt Machine Co., Louisville, Ky., has recently issued a 27-page bulletin descriptive of the Vogt water tube boiler explaining various features connected with the design, construction, fuel consumption and other operating details. It is a valuable treatise for anyone contemplating the installation of a boiler plant containing as it does a complete description of a well designed boiler plant and a discussion of all the various factors entering into the construction of the steam power plant.

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"Separation of Palladium and Platinum by Means of Dimethylglyoxime," Serial 2351, obtainable from the Bureau of Mines, Washington, D. C. In the investigation of methods for assaying platinum, conducted by the Bureau of Mines, recent experiments have developed that with certain ores, especially when the quantity of platinum is considerable, nitric acid will not effect a separation of platinum and palladium. A method which has been found to be accurate and to result in a complete separation of these metals is described in this serial.

"The Tannic Acid Method for the Quantitative Determination of Carbon Monoxide in the Blood," Serial, 2356. Bureau of Mines, Washington, D. C.

A method which is believed to be particularly adapted to the determination of poisoning by carbon monoxide. The preliminary announcement sent out by the Bureau of Mines calls attention to the fact that it is particularly essential indeed for doctors, coroners, safety engineers, and first-aid men to be able to recognize this poisoning, not only as regards giving proper treatment, but to ensure just decisions on claims and to eliminate false illusions and complaints of workmen.

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The Mackinac Development Co. has been organized to investigate the feasibility of building a bridge across the Straits of Mackinac, or a tunnel under the straits. Engineers believe that the most feasible route for a bridge would be between Cheboygan, Mich., and St. Ignace, Mich., utilizing several islands in the straits. Charles Evan Fowler, consulting engineer of New York, has been retained to do the investigation work.

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The production of copra in western Samoa for 1921 is estimated at 11,500 tons, an increase of 1,400 tons over the yearly average for the past decade, says Vice Consul Quincy F. Roberts, Apia, in a recent report to the Department of Commerce.

Compressed air drills in both the American Commander and the Independence Lead mines in the Coeur d'Alenes are expected to hasten development. In a wire to the Lauzier-Wolcott company, H. B. Kingsbury of Wallace said recently:

"All faces in the Independence Lead mine are still in ore and with the air drills installed next month good news will be plentiful.

"American Commander compressor is running. The crew is busy getting things in shape for starting work in the No. 1 tunnel on the 15-foot vein."

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In the London-Paris airplane service a new record was made by Captain E. D. C. Horne on May 1. Using the new DH 34 machine, he made four successive single trips between the two capitals in the interval from 6.55 a. m. to 5.40 p. m. Out of the ten and three-fourths hours between his first ascent and his last descent he spent eight hours 52 minutes actually in the air.

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The Northern Peru Mining & Smelting Company which has a three-year option on the Quiruvilea copper mines proposes to build a railway line from their mines to Trujillo, but if the Chiquicara branch of the Chimbote-ecuay line is extended it will run only fifteen kilometers from the mines. This company proposes also to build a hydro-electric plant at Motil, twelve miles southwest of Quiruvilca, and a smelter also if needed.

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England has an automobile run with gas produced by a generator installed in the car. Hard coal, coke and wood charcoal were used as fuel. The gas producer works automatically and a steady stream of gas is produced. No changes need be made in the motor when gas is used as the motive power. The advantage gained lies in the fact that the gas fuel admits of a higher compression in the cylinder than gasoline, which results in a greater efficiency in the utilization of the heat value in the motor fuel.

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In Birmingham, England, and also in Manchester the yearly deposit of soot is as much as a ton per acre, or 640 tons per square mile. This of course all comes from bituminous coal, and yet the English generally have an ineradicable idea that anthracite is an inferior fuel.

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The Ballou White Sand Co., Millington, Ill., is completing the installation of a complete air separation system for the making of fine dry silica, in mesh from 60 to 150 and can get a very close size in each mesh. This system makes a very high grade "banding sand."

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The world's sixth green diamond has been found in the Bloemhof district, according to a report from Johannesburg. Its weight is one and a half carats and it is valued at $25,000 to $30,000. Until the discovery there were only five other known green stones. One of them was owned in the United States.